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THE SURGICAL TREATMENT OF DIVERTICULITIS

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and
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DIVERTICULA occur in all portions of the gastrointestinal tract from the esophagus to the rectum, but most frequently are found in the sigmoid colon. Approximately 5 per cent of colon x-rays made for symptoms show the presence of sacculations in some portions of the large bowel. These symptomless lesions become of interest and importance when they undergo inflammatory changes which are due, perhaps, to their inability to empty completely, with stagnation and irritation resulting.

As early as 1700 Littre mentioned "diverticula hernia" without sufficient elaboration to establish clearly the condition he had in mind. However, in 1849 Cruveilhier adequately described diverticula of the colon. The terms "chronic adhesive peritonitis" and "peridiverticulitis" introduced in 1853 by Virchow marked the beginning of pathologic studies. In 1858 Sydney Jones was the first to report a case of diverticulitis complicated by fistula into the bladder. Edwin Beer in 1904 offered a comprehensive consideration of the etiology and pathology. The first record of operative cases was made in 1907 by Wilson, Giffin and W. J. Mayo, who presented five cases in which a portion of the sigmoid had been resected.

From the first description to the present, various suggestions have been made relative to the etiology, but none of them has proved entirely adequate. They vary from muscle weakness, neuromuscular dysfunction, increased intracolonic pressure, and vascular stasis to the degenerative changes of senility. Poirier and Charpy believed that the sacculations resulting from the longitudinal muscle bundles

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EKT.

retarded the passage of feces and in constipated patients predisposed to diverticulum formation. The site of blood vessel entry into the intestinal wall was considered a potential hernia or weak spot by Klebs. On this same basis Ernest Graser believed passive congestive states enlarged these openings. Sudsuki, however, offered evidence in rebuttal. He studied 28 cases of heart disease with congestive failure and found only 6 cases of diverticula. Another series of 12 cases of diverticula were without the slightest evidence of vascular congestion. These are but a few of the many theories, all with a degree of interest, but none adequately accounting for the condition. At best it seems logical to assume that from an unknown cause, probably congenital, a weakness exists in the intestinal coats and by reason of this a pouching of the coats takes place when any undue pressure arises.

A study of the incidence, sex, and age of the patients affords direct and enlightening information. The individual reports, however, may show slight variation. Larimore, in 1925, reported a series of 4,406 x-ray examinations of the colon with the finding of diverticula in 1.25 per cent. Spriggs and Marxer two years later reported a smaller series of 1,000 cases similarly examined with a higher incidence of positive findings, namely, 10 per cent. Rankin and Brown with a much larger series (24,620 cases), examined after barium enema, found diverticula in 5.67 per cent of the cases. Probably an average incidence of 5 per cent in the cases examined by barium enema will go unchallenged, although we must remember that this does not represent the frequency of occurrence in all patients, but only in those with sufficient symptoms referable to the gastrointestinal tract to warrant special examination. Abell gleaned from a study of the literature a clinical and x-ray incidence varying from 1.7 to 8 per cent. Robertson, reporting from an entirely different source of material, namely a necropsy service, found the condition in 5 per cent of all cases over 40 years of age coming to postmortem.

In the various studies the factor of age has been less variable, the vast majority of cases occurring in patients beyond 40 years of age. There have been some exceptions, notably Ashhurst's report of a child 7 years of age, Hartwell and Cecil's two cases in which the patients were 7 and 10 years of age respectively, and Ransohoff's one case of a child 3 years old.

The influence of sex is negligible. In a series reported by Rankin and Brown, 60 per cent of 481 patients were males. In the group of cases studied by Ochsner and Bargen in which the patients gave a history of diverticulitis, males exceeded females in a ratio of 1.25 to 1. This ratio of the sexes does not hold in chronic constipation which is predominant in females and should eliminate this condition

as a causative factor; nor does this ratio hold for the complications, especially the serious complications which are more frequently observed among men. The impression that fat people were especially prone to this affliction has been definitely dispelled by careful observers who have noted that the thin are equally affected.

In order to evaluate more carefully the significance and importance of diverticula, we use the following classification, as previously suggested:

1. Diverticulosis, including that group of cases in which evidence of diverticula is found by roentgenographic examination or at necropsy and in which, from all available data, the diverticula do not bear any relationship to the patient's complaint.

2. Diverticulitis
   a. Acute
   b. Chronic
   c. Complicated
      1. Abscess formation
      2. Fistula
         External
         Internal { vesicocolic / enterocolic
         Multiple
      3. Associated with malignancy.

Ordinarily we consider acute, subacute, and chronic diverticulitis to be fundamentally medical problems and the complications essentially surgical.

The distribution or location of the vast majority of diverticula in the left colon, where the walls are thicker, lumen less distensible and the content more formed, accounts for alteration of bowel habitus as an outstanding symptom and the more frequent complications by virtue of proximity to the pelvic viscera. Hunt found diverticula more numerous in the sigmoid, to which portion in his experience they were confined in 75 per cent of the cases. Abell estimates 85 per cent in the sigmoid and descending colon, more in the former. Judd, Pollock, and Masson found 77.8 per cent in the sigmoid.

Diverticula, according to Bell, chiefly of academic interest, are frequently encountered in roentgenologic examination of the gastrointestinal tract where they are outlined as sacculations along the lumen of the large bowel, and uniformly asymptomatic. The presence of inflammatory reaction occurs in from 10 to 20 per cent (Abell), and makes diverticulitis a separate entity with a distinct

roentgen-ray picture and clinical syndrome. The uncomplicated cases usually manifest themselves by some alteration in bowel habits. Approximately 40 per cent of the patients complained of constipation alternating with an occasional spell of diarrhea. Associated with the irregularity of the bowel habit is a variable degree of pain, ranging from a mild heaviness, fulness or soreness to severe cramps which often simulate a left sided appendicitis. With increased narrowing of the bowel lumen by the inflammatory process and fixation to adjacent structures, a mass may be felt and various degrees of obstruction will take place with nausea, vomiting, and often stools of reduced caliber. Bleeding is rarely profuse; an occasional streak of bright red blood or tarry particles may be observed. According to Abell it occurs in 5 per cent of the cases; Jones, who quoted Spriggs, found the occurrence in 13 out of 68 cases in his series; and it occurred 33 times in 227 cases, an incidence of 15 per cent, in Rankin's series. The symptoms in the uncomplicated cases are due directly to the mechanical factors of a reduced lumen and fixation and ulceration which result from secondary infection.

The clinical diagnosis alone of this condition is not reliable, but roentgenology in the hands of a competent man is the most accurate means of recognition. This means of investigation may at times be supplemented by proctoscopy. Diverticula manifest themselves roentgenoscopically and roentgenographically as rounded, knob-like projections from the lumen of the colon and show considerable variations in size. With the presence of diverticulitis are added signs of irritability, chiefly spasm and hypermotility. All degrees of spasm and filling defects may occur and may occasionally be confused with carcinoma. The differential points usually are the concentric contours in diverticulitis, contrasted with the sharply irregular contours in carcinoma and the maintenance of motility usually in the former as compared with immobility in carcinoma.

Proctoscopic examination is particularly valuable in the acute phases where one might fear to give a barium enema. The presence of fixation or demonstrable diverticula as revealed by this examination will often make the diagnosis. This has been shown in 20 per cent of the cases of diverticulosis and 64 per cent of diverticulitis. Occasionally when diverticulitis becomes adherent to the bladder or ureters and gives rise to urinary symptoms and even blood and pus in the urine, cystoscopic examination and intravenous urograms may prove necessary to eliminate primary genito-urinary disease. The relationship between cancer and diverticulitis apparently is not an actual fact but rather a coincidental finding. The mimicry of cancer by diverticulitis was called attention to by Lord Moynihan many years ago and indeed the observation is an important one particu-

larly in the presence of a huge tumefaction in the sigmoid. It is emphasized that one should never dismiss such a case with a colostomy as a hopeless malignancy without every effort being made to exclude diverticulitis. Not a few instances are recorded where the surgeon has, after colostomizing the patient, condemned him to a hopeless prognosis from cancer and been surprised to have the patient improve and continue to live out a normal existence. It is often difficult and sometimes impossible to differentiate between the two lesions by x-ray alone, but in 227 cases reported by Brown and Rankin, cancer occurred coincidentally with diverticulitis in only four.

Bleeding is the most common symptom of cancer and when it occurs in the presence of a diverticulitis should emphasize the likelihood of a coexisting malignancy, but bleeding alone without other roentgenologic or clinical evidence is insufficient to make such a diagnosis, for bleeding from diverticulitis alone is almost as common a happening.

The diagnosis of the acute group which perforate into the peritoneal cavity without formation of abscesses, is a difficult task and unless the presence of diverticula has been known previously or the patient has undergone treatment for diverticulitis, accuracy is more apt to be the exception than the rule. The attack usually is ushered in as an intraperitoneal disaster of considerable fulmination. The low pain, the leukocytosis, the tenderness, the elevation in temperature are not characteristic but usually are confused with appendicitis. The two most frequent mistakes in diagnosis of acute perforation of diverticulitis are to call it acute appendicitis or a ruptured duodenal ulcer. Either of these errors places both the surgeon and the patient at a disadvantage because exposure of a sigmoid colon is difficult or impossible through the incision usually used for an appendix or a duodenal ulcer. In dealing with this group, Graham has emphasized the great necessity of first correcting biologic disturbances which inevitably follow acute abdominal disaster by the intravenous use of fluids and salt and other necessary remedies to restore the physiologic equilibrium.

In the following series of cases to be presented will be found ones representative of the most common complications occurring with diverticulitis chiefly, first, the mimicry of carcinoma; second, subacute or acute obstruction requiring surgical relief; third, gross hemorrhage, threatening the patient's life; fourth, perforation into adjacent hollow viscera with fistula formation; fifth, perforation with either general peritonitis or local abscess formation and fecal fistula; and sixth, diverticulitis of the cecum, presented as an unusual finding or occurrence, and simulating a malignant tumor. These cases oc-

curred in our private practice, but the conclusions and observations in this paper are gleaned from the study of 227 cases of diverticulitis reported from the Mayo Clinic by Brown and Rankin and supplemented by 27 cases seen by us since 1933.

Diverticulitis Simulating Cancer

Case 1.—A white woman, aged 66, was first seen March 25, 1934. Her chief complaints were abdominal cramps with residual soreness in the lower left quadrant; increasing constipation of three weeks' duration; stools reduced in size and containing streaks of bright blood which had been present at intervals for a year or more.

Physical examination revealed the operative scar for removal of a stone from the left kidney in 1931, and tenderness 1 plus in the lower left quadrant. Vaginal examination was essentially negative.

Rectal examination revealed a mass high in the left side which was interpreted as being a segment of bowel prolapsed into the cul-de-sac. Proctoscopy for 25 cm. showed a normal bowel lumen. Roentgenologic study after barium enema revealed a constant, irregular, eccentric deformity consistent with malignancy. There were no other significant clinical findings. Examinations of the blood and urine were essentially negative.

Diagnosis: Cancer of the sigmoid.

The patient was subjected to five days of preoperative treatment, which consisted of colonic irrigations and a non-residue diet. At exploration on March 31, a mass was found in the middle of the sigmoid to which was attached the right tube and ovary. The mass was mobilized and exteriorized.

The postoperative course was satisfactory and on the tenth day the exteriorized mass was removed by cautery, leaving the equivalent of a double-barreled colostomy. She was dismissed on the twenty-fifth postoperative day, but returned three weeks later for application of clamps to the colonic spur, which created a lumen adequate to allow passage of the fecal current to the lower loop and rectum with consequent spontaneous closure of the colostomy.

Pathologic Report: Diverticulitis.

Case 2.—A white woman, 70 years old, was seen Nov. 2, 1936. She complained of five attacks of severe lower left quadrant cramps, starting six months previously, which at times had extended to the vagina and rectum and had been accompanied by nausea and vomiting; black stools had been noticed on two or three occasions, but no bright blood or mucus. There had been increasing constipation and soreness in lower left quadrant; and slight frequency and urgency.

Her history otherwise was negative. Examination showed the abdomen to be slightly obese and tender 1 plus on deep pressure in the lower left quadrant, with no palpable masses or organs. Vaginal examination was negative except that a mass could be felt high on the left side apart from the adnexa. Digital rectal examination was negative as was proctoscopy for a distance of 25 cm. X-ray of the barium filled colon showed a defect in the sigmoid characteristic of cancer. The blood and urine examinations were negative.

Diagnosis: Cancer of the sigmoid with chronic obstruction.

Operation: November 5, under gas-ether anesthesia the patient was explored through a low midline incision. A mass was found in the sigmoid about 2

inches above the rectosigmoid juncture. After mobilizing and palpating it, a definite diagnosis could not be made. The rectum was mobilized from the bottom of the pelvis and the tumor brought up. An obstructive resection with the Rankin clamp was then done followed by a complementary cecostomy.

A routine transfusion of 500 c.c. of blood was given and a satisfactory convalescence followed. On the ninth day the clamp came off; clamps were applied to the colostomy spur on the eighteenth postoperative day. Six weeks later the colostomy had completely healed spontaneously.

Pathologic Report: Acute and chronic diverticulitis.

This case, like the preceding one, exemplified diverticulitis presenting obstructive symptoms and so closely simulating cancer that the true diagnosis awaited the pathologic study. Both presented the clinical picture of subacute obstruction with the usual features, namely, of bowel irregularity, abdominal distension, and intermittent cramps. The stools contained small amounts of bright blood, a finding consistent with either the degenerative changes of malignancy or ulceration resulting from infection. The age of both patients would easily place them in the limits of the carcinoma or diverticulitis bracket.

The roentgenologic studies, our most dependable single diagnostic aid, were interpreted as malignancy and little criticism could be made of the roentgenologist's error when at exploration with the tumor in direct view the same opinion was held. The discussion herewith is concerned primarily with diverticulitis per se, indistinguishable from carcinoma and not with the associated or coexisting lesions which are infrequent. Hunt could find little evidence that cancer develops on diverticulitis. Abell's study of the literature indicates an incidence of from 1.7 per cent to 8 per cent. Of 227 cases of diverticulitis requiring surgical treatment, Rankin found coexisting cancer in only 4 cases and in 679 cases of cancer of the colon operated, coexisting diverticulitis in only four. Bargen and Ochsner found malignancy in 6 per cent of their cases in which diverticula were discovered by clinical methods; the association was noted only among the patients who had diverticulosis, and who did not give a history suggestive of diverticulitis. In only seven of the thirteen cases in which it was noted, was the malignancy in that portion of the colon in which the diverticula were found. Aside from the incidence of cancer in association with diverticulitis varying from 1.7 to 8 per cent there are encountered cases of primary diverticulitis with clinical roentgenologic and gross appearance of malignancy.

Case 3.—A man, 51 years old, was first seen Oct. 26, 1935. Chief complaint was mild pain localized to lower right side, continuous for 20 hours, unaccompanied by nausea or vomiting but with definite tenderness. Previous medical and surgical history were negative.

Examination showed definite guarding and tenderness 1 plus over the appendix and in the costovertebral angle slightly posteriorly. No masses or organs were felt and the genitalia were normal. Rectal examination was negative; temperature, 99; urine, negative; leukocytes, 12,660 with 87 per cent polymorphonuclears, 9 per cent lymphocytes, and 4 per cent monocytes.

Diagnosis: Acute appendicitis.

Operation: October 26, through a McBurney incision, the cecum was exposed and a mass was felt and thought to be a retrocecal appendix but when the cecum was delivered the appendix was found to be obliterated and separate from the tumor in the cecum. The latter was situated on the lateroposterior wall and had a definite crater, the base of which was a little larger than a silver dollar with inflammatory reaction around it. Aseptic lateral anastomosis between the terminal ileum and the transverse colon was done. The tumor was returned to the abdomen to be resected later.

On Dec. 4, 1935, the abdomen was explored through a mid-right rectus incision. The stomach, liver, and gall bladder were normal. The cecum was mobilized and resected. Peritonealization of the raw surfaces was complete.

Diagnosis: Cecal diverticulosis with one diverticulum showing acute inflammation.

Case 3 is similar to the previous two in that it mimicked carcinoma. Its chief point of interest, however, lies in its location. Malignancies of the cecum and right colon are not oddities, while diverticula in this location are more likely to incite curious interest and no little confusion when associated infection is creative of a tumefaction. Clinical diagnosis in this case had been carcinoma. The pathologic proof, however, following its removal revealed its true inflammatory nature. Deceptive tumors of this type are unusual in our experience. Most of us have encountered disease of the appendix, either an abscess or a thickened retrocecal viscus giving rise to fixation and a false sensation of a tumor. It simulates malignancy by virtue of its fixedness, slowness of development, and often lack of evidence of acute inflammation. Occasionally tuberculosis of the appendix is responsible for the pathologic change. We believe that diverticulitis of the cecum resulting in a tumor simulating carcinoma is rare.

Case 4.—A married woman, 63 years of age, was first seen Feb. 11, 1937. Ten years earlier she had begun to have bladder trouble with recurrent urinary distress characterized by frequency day and night, dysuria, and marked burning sensation and soreness over the bladder. With the last episode which had begun three weeks previous there developed severe pain in the whole lower abdomen, particularly the lower left quadrant without other extension, accompanied by violent chills, temperature elevation to 104, and profuse sweats. Four days before coming to us for examination she passed gas and feces through the bladder and was somewhat relieved.

Ten years before, a few months after the menopause, a small tumor, said to be a fibroid, had been removed from the uterus.

Physical examination revealed an old low midline scar in the abdomen and a large, firm, slightly irregular, somewhat tender mass arising out of the pelvis and into the abdomen on the left side to the level of the anterior superior spine. A slight purulent discharge was found in the vaginal canal but there was no evidence of feces or fistulous openings; the uterus was indistinguishable from the left sided abdominal mass. Rectal examination confirmed the left-sided pelvic mass. Proctoscopic examination was negative for 18 cm. at which point the lumen above seemed obliterated by extraluminary pressure. Because of the obstruction and acute illness of the patient it was thought unwise to x-ray the colon.

Several examinations of catheterized urine were essentially the same, namely, a specific gravity of 1.010, acid reaction, 2 plus albumin, a heavy sediment, and microscopic examination revealing 100 to 175 red blood cells per h. p. f., pus cells too numerous to count, and numerous bacilli. An intravenous urogram showed both kidneys and ureters to be fairly well filled. There were multiple discrete, calcified nodules in the pelvis, and one large calcified mass just above and pressing on the wall of the bladder which was thought to be a uterine fibroid.

On February 17, the patient was explored through a low midline incision. There was found in the pelvis a mass the size of a grapefruit, which appeared to consist of the top of the sigmoid loop, the bladder, uterus, and a loop of small bowel. There was a great deal of inflammatory reaction suggesting diverticulitis. A loop colostomy in the sigmoid segment was made and brought out through a stab wound in the left groin. The convalescence was very satisfactory and the patient was dismissed three weeks after operation.

On May 10 the patient returned having gained weight and strength. She had had no chills, fever, or abdominal pain. There was diuria 5 to 10 times with occasional burning but no gas or feces. Catheterized urine showed acid reaction, specific gravity 1.020; 2 plus albumin; 3-5 blood cells per h. p. f.; pus 60-100; bacteria few.

X-ray of the barium filled colon from the rectum was done and reported, "There is some narrowing of the bowel just distal to the colostomy, apparently due to diverticulitis, as multiple diverticula can be seen in this area." There was practically no obstruction to passage of the enema. The left pelvic mass previously described was found to have been reduced to at least one-half in size and was freely movable. The patient was sent home to return in three months for re-examination.

Sydney Jones, in 1858, was the first to report a case of diverticulitis of the colon complicated by fistula into the bladder. Case 4 in our series represents such a complication. There seems logical reason for many of the features presented by these cases. The occurrence of diverticulitis in the sigmoid in 75 to 80 per cent of the cases (Hunt, Abell, Pollock, Judd, etc.) is significant. This segment of bowel is likely to be redundant and with the patient upright, it becomes dependent in the proximity of the urinary bladder. Inflammatory processes with exudate are adhesive and with active diverticulitis the sigmoid when in contact with the bladder soon becomes fixed to it. Infiltration soon ensues with active and actual involvement of the bladder wall. The process then pursues one of two

courses, resolution with healing, or progression with perforation and fistula formation. In considering any surgical attack there are certain more or less constant hazards. The site of attachment and fistula is too frequently at the base of the bladder, where immobility and the presence of the ureters make direct surgery difficult. A small opening is not always to be found which will lend itself to easy closure, extensive infiltration making suturing ineffectual. One must often be content with a colostomy to allow for subsidence of the inflammation and contemplate repair or plastic procedures several months subsequently.

CASE 5.—*Diverticulitis with gross hemorrhage.*

The patient, first seen Nov. 13, 1934, was a white woman, 68 years old, complaining of diarrhea accompanied by slight pain and soreness in the lower left abdomen. On one occasion she had passed a large amount of bright blood, causing her to faint. Eight years previously she had had an attack of sharp pain in the lower left quadrant followed by hemorrhage. X-ray studies revealed diverticulitis. During this interval there had been no bowel complaint.

Examination revealed the abdomen to be soft and containing no masses. No masses could be felt by rectum; the temperature was 99.6. Urinalysis was negative; erythrocyte count was 3,230,000; hemoglobin, 61 per cent; and leukocytes, 10,200 with 70 per cent polymorphonuclears and 30 per cent lymphocytes. X-ray of the barium filled colon revealed multiple diverticula throughout most of the colon, with some intermittent spasm, especially in the sigmoid.

The routine medical regime was started which consisted of a bland, nonresidue diet, and mineral oil. The patient was soon dismissed from the hospital on the above management and has remained relatively free of symptoms to date.

Mention has previously been made of the incidence of bleeding in association with diverticulitis of the sigmoid. It varies from 5 to 17 per cent according to numerous reports. However, it usually consists of a small amount of bright blood on the stool; gross hemorrhage is most unusual. Case 5 is representative of such an occurrence. The consideration and treatment of gross or exsanguinating hemorrhage of the colon from diverticulitis will seldom excite attention. The thing just does not occur, except with exemplary rarity. If one should be faced by such an emergency, conservatism in management is usually priceless judgment. The bleeding results from lesions in association with inflammation and necrosis and is more likely to involve small vessels which will likely collapse with the fall in blood pressure before fatal loss has occurred. Restraint of bowel activity, sedation, and heat to the abdominal wall, are usually adequate. Transfusions are always in the offing when a crisis presents. When the emergency is met, the usual medical regime is instituted. Surgery is considered only with repeated gross hemorrhage and associated complications.

CASE 6.—A physician, 51 years of age, who since 1909 had had recurrent at-

tacks of diarrhea and frequent severe sharp pains in the lower left quadrant with urgency. The latter was usually relieved by passage of large soft stools. Stools had never been tarry nor contained bright blood or mucus. Between attacks bowels were regular without aid of laxatives. In April, 1936, he had an attack of severe pain localized to the lower left quadrant with elevation of temperature to 101 and leukocytes to 14,500. Exploration by his home surgeon revealed a large acutely inflamed mass in the sigmoid filling the pelvis, which was attached to the bladder and had loops of small bowel adherent to it. A diagnosis of perforating diverticulitis was made and the operation terminated by inserting drains to the dependent levels. The convalescence was uneventful but a fecal fistula resulted with drainage from the lower angle of the wound.

After dismissal from the hospital the old symptoms of pain, soreness, and diarrhea returned, but when first seen and examined by us in February, 1937, the patient did not appear ill. Examination revealed a recently healed low right rectus scar with a fistula in the lower end from which small amounts of pus could be expressed. The left side of the lower abdomen was tender but there were no palpable masses or organs. The rectum was slightly strictured from a fistulectomy performed in 1913. Proctoscopy for 25 cm. was negative except for the contraction at the outlet.

This case has many interesting features, some of which are not unusual, particularly in the management. The history of this case is longer than usual if the spell of diarrhea 23 years ago could be interpreted as diverticulitis. This assumption seems logical in view of the recurrent attacks from that date. The present illness which led to surgery and subsequent complications is illustrative of several interesting facts.

At the onset there was general malaise of three or four days followed by lower abdominal discomfort, soreness, and diarrhea for several hours, then an attack of severe pain localized to the lower left quadrant. The temperature was elevated to 101, leukocytes numbered 14,500, and the physical findings were those of acute appendicitis with the exception of localization to the left side. At exploration elsewhere the findings revealed a large inflammatory mass which involved the sigmoid, bladder, and small bowel. There was no generalized peritonitis. This typifies the usual behavior of an acute diverticulitis with perforation. The process rarely gives rise to a generalized peritonitis but to a localized abscess which so frequently is walled off by adjacent viscera. The attack of acute pain possibly coincided with the perforation. Drains were inserted to the site of the tumefaction and in the dependent portion of the pelvis, with the usual development, namely, a fecal fistula.

Immediate recovery from this experience was fairly satisfactory but the usual phenomena of recurrent obstruction, intermittent blockage of the fistulous tract, and bladder pain from pressure of the inflammatory mass ensued. When explored by us the pelvis seemed almost obliterated by a large mass which following dissection was found to contain the bladder, small bowel, and a thickly indurated,

inflammatory lesion in the sigmoid, all of which were attached to the dome of the bladder. The fistulous opening was excised and was found to connect with both the small and large bowel. It was necessary to resect a part of the small bowel in closing the fistulous opening into its lumen. The sigmoid was liberated from the bladder without damage to its integrity. The tumefaction was exteriorized as a first stage operation and removed seven days later by cautery, leaving the equivalent of a double-barreled colostomy. In time this bowel spur was removed by an enterotome and the fecal current directed through the rectum. This case is highly illustrative of perforative activity of diverticulitis, the nature of the inflammatory lesion, the tendency to involve adjacent viscera, the formation of a fecal fistula when drains are used, and the necessity for extensive operation to correct these many complications.

Treatment

The treatment of diverticulitis, like that of duodenal ulcer, is the treatment of its complications. The type of operative maneuver applicable to surgical diverticulitis depends upon the complication which converts a symptomless lesion into a surgical one. If a diverticulum has perforated into the peritoneal cavity an emergency operation is indicated, but the exact type to be indulged in is not entirely standardized.

In the vast majority of instances, acute perforating diverticulitis will present somewhat atypical symptoms of acute appendicitis, be diagnosed and operated upon as such. Unfortunately in this event the surgeon usually uses a McBurney incision or a right rectus incision, and upon finding a normal appendix begins an exploration which, because of the difficulties present, is of itself a formidable procedure. If a McBurney incision has been used it should be closed immediately and a low midline incision substituted for it. This brings one down upon the pelvis, allows an inspection of the sigmoid and pelvic viscera, permits packing-off of the abdomen and prevents spread of infection easier than any other type of incision.

Since most diverticulitis occurs in the sigmoid, the exploration usually reveals a single diverticulum perforating free into the peritoneal cavity. This is closed loosely with interrupted sutures approximating the lips of the opening, and epiploic tags are fastened down to assist in plugging the hole. The customary routine following this is to put a number of drains, one of which is a Penrose with vaseline gauze, around the opening. When such a procedure works satisfactorily it is admirable, but frequently it is followed by fistula formation and it seems to us a logical step to supplement this closure

and drainage with a colostomy which shunts the fecal current. Since a perforation occurs in a single diverticulum or a conglomerate mass of several diverticula, there usually are a number of other sacculations along the sigmoid and a colostomy not only is valuable in the immediate emergency, but permits inflammatory changes to regress and the other inflamed sacculations to return to normal or be obliterated.

This colostomy is easily made with only a few moments additional time by picking up the proper point in the sigmoid, slipping a rubber tube around it without interfering with any of the blood supply, and pulling it out quickly through a stab wound in the flank, to be opened at the end of 36 to 48 hours. Were the maneuver time-consuming, difficult, or burdensome in any way to the individual, its employment might be criticized, but the ease of performance and the advantage of shunting the fecal stream so readily recognized in the chronic obstructing type of diverticulitis, argue in its favor. It is regrettable that we have not had a long enough series of personal cases to report statistically on this procedure, but in the small group in which it has been used, it has seemed to have a distinct place in the treatment of diverticulitis.

A type of diverticulitis which may require resection is the perforating type, which walls off, forms an abscess which burrows through the tissues, and finally after a long period of expectant treatment presents itself under the skin of the anterior abdominal wall to be incised and drained. The residual abscess having been evacuated, a sinus tract forms which occasionally discharges particles of fecal material and is a constant source of annoyance to the individual. There is little tendency for these sinuses to heal. The routine treatment is to temporize with them, and properly so, for to explore them until every effort has been made to allow nature to heal the process is to indulge in a hazardous procedure which usually winds up in resection.

The two favorite places for a diverticulitis to attach itself seem to be the anterior abdominal wall and the bladder. The latter requires special consideration not only from the standpoint of an abdominal lesion but because of the urologic complication likely to develop. Where a sinus tract which has developed on the anterior abdominal wall has failed to heal despite conservative measures, one usually is forced to an exploration, and frequently a resection. It has been our experience that this exploration is best carried out through a low midline incision, that the sinus be divided, the whole sigmoid lifted out and left either as an exteriorization operation or that an obstructive resection be employed with or without a complementary cecostomy as the indications present.

Where obstruction is the main factor, where there is a large immobile mass imbedded in the pelvis without urinary complications and without clinical or roentgenologic symptoms to indicate the likelihood of a coexisting malignancy, a simple loop colostomy above the mass is the procedure of choice. This by-passes the fecal current and if allowed to remain for a period of six months to a year is very likely to result in the complete disappearance of the inflammatory mass and permit the reestablishment of the gastrointestinal lumen. We have seen, at the end of twelve months, a mass which almost completely filled the pelvis and which was almost completely obstructing, disappear entirely leaving an apparently normal bowel. It should be emphasized that time is an important factor in this particular type of procedure and that attempt at closure of the colostomy at too early a date is distinctly unfavorable. It should be tolerated probably for twelve months as a rule, although there are certain exceptions to this, and the recent suggestion of Pemberton and Waugh that these low diverticulitis cases will be improved materially by the Elliot treatment seems a most sensible and favorable one. It should reduce the morbidity in these cases enormously, and certainly cannot be harmful in any way.

The treatment of diverticulitis when associated with vesicle fistula demands that one consider very carefully any damage which may have been done to the urinary apparatus by the infection which necessarily is present in the bladder. A resection of diverticula which have perforated into the bladder should never be attempted until a primary colostomy has been done and whatever infection present in the kidneys and bladder has been entirely eliminated. Morrissey, of New York, and others have urged the necessity of this maneuver and in our hands it has for years been considered of the gravest importance.

Following the elimination of the vesicle fistula and satisfactory re-establishment of the urinary balance, one again explores the abdomen through a low midline incision and does whatever type of resection seems essential. These are difficult operations—the sigmoid drops down into the bottom of the pelvis and shows a tendency in most of the cases to fasten itself close to the entrance of the ureters into the bladder. When one undertakes to separate the bowel from the bladder without relieving acute inflammatory reaction by colostomy, one finds edema and infiltration in the tissues which make for difficult healing with a consequent unsuccessful outcome.

Summary

1. Diverticulosis of the large bowel occurs most frequently in the sigmoid colon and is present in about 5 per cent of colon x-rays made for symptoms.

2. Diverticulitis occurs in from 15 to 17 per cent of the cases of diverticulosis and requires surgical attention in one case out of eleven.

3. The relationship of cancer to diverticulosis is incidental.

4. The outstanding symptom of diverticulitis is low abdominal pain associated with constipation. Tumefaction is present in 31 per cent of the cases. Change in bowel habit occurs irregularly and bleeding is an occasional symptom of otherwise uncomplicated diverticulitis.

5. The difficulty of differentiation between an advanced cancer of the sigmoid and diverticulitis with tumefaction is sometimes great and in all apparently inoperable cancers of the sigmoid which have not metastasized, diverticulitis should be excluded.

6. Where fistula formation with the bladder is present, primary resection should not be done. Urinary infection should be cleared up by a colostomy and proper bladder treatment before extirpative maneuvers are indulged in.

7. Resection of the sigmoid for diverticulitis usually is best accomplished by graded maneuvers.

8. It is felt that colostomy should be a part of an operation for acutely perforating diverticulitis.

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A NEW SKULL-TRACTION APPLIANCE

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NO satisfactory method of traction for fractures or dislocations of the cervical vertebrae and their complications has been described before so far as I know. The "halter" traction cannot be used when the jaws or face are injured and even when these complications do not exist it is unreliable, uncomfortable and interferes with feeding. The tongs now on the market will not allow enough pull to reduce the deformity in many cases because the traction is on a small pin pulling against the flat plane of the thin, outer table of the skull. I know of several instances where these tongs have cut through this thin bone so that it is the practice of many surgeons to allow only 7½ or 8 pound weights. This is entirely too weak a pull.

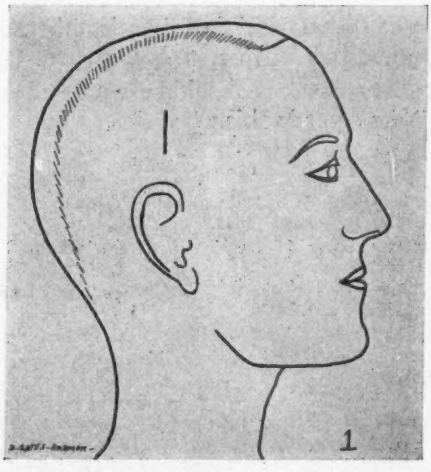

Fig. 1. Diagram to show the site of the scalp wound and the direction of the incision.

The appliance I am to describe allows from 25 to 35 pounds traction. Instead of the pull being made by a small pin against the thin, flat surface of the outer table, the traction is made by a rod 3/16 inch in diameter pressing against the edge of the outer table, thus increasing the amount of pull possible. Side pressure against the edge rather than pull against the thin, flat surface is the principle involved.

Exhibited before the Medical Association of Georgia, Macon, May 11-14, 1937.

Technic: The sides of the head are shaved and prepared as for any skull operation. A 1 inch, vertical incision (Fig. 1) is made just above the ear, slightly posterior to the line of the external, auditory meatus. The center should be just below the temporal ridge. It is carried down to the bone, from which the pericranium is loosened and retracted. A ¼ inch opening is made through the outer table just below the temporal ridge by means of a small trephine with a depth control sleeve.

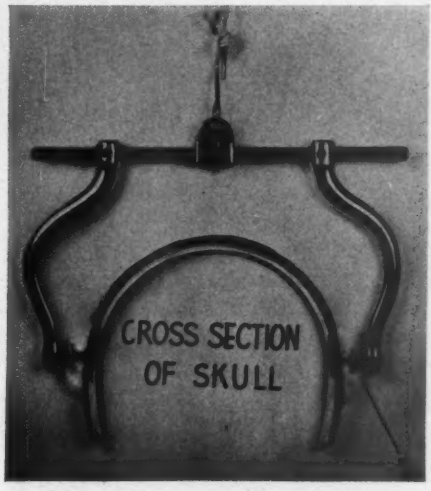

Fig. 2. The instrument.

The appliance is now adjusted so that the points (Fig. 3-A) are inserted into the openings just far enough to allow the eccentrically placed head to hook upward beneath the outer table and yet not press upon the inner table. (Fig. 3.) The set screws are tightened with a wrench to prevent slipping. While an assistant applies slight traction the scalp wounds are closed up to the pin and vaseline gauze wrapped around it above the skin. The threaded washer (Fig. 3-B) is tightened just enough against this to prevent slipping and then both wounds are covered with dressings and bandage.

I use a simple frame with pulley (see photograph) attached to the headrest of the bed to support the cord and weights. The head and foot pieces of the bed are interchanged so that the low foot piece will allow the back-rest and traction ensemble to be elevated or lowered at will without disturbing the pull. A feather pillow is placed beneath the dorsal region so that the direction of the cord

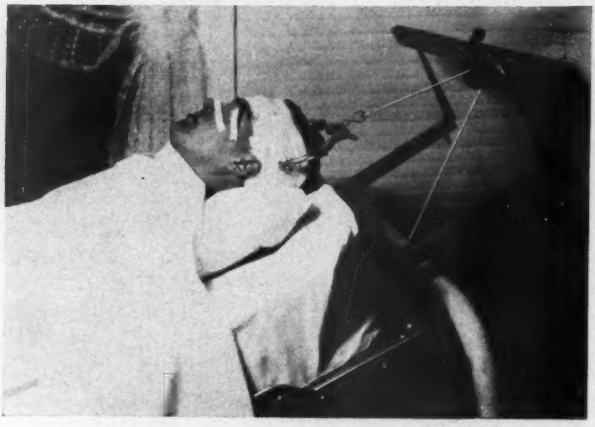

Fig. 3. The instrument in use.

and pull can be a little downward. A doughnut ring is placed beneath the head to prevent pressure sores. This method allows ample pull, does not interfere with feeding or injuries to the jaw, and is much more comfortable for these unfortunate patients than anything heretofore offered.

Note: The trephine is exactly ¼ inch in diameter and has a sleeve with set screw on it to control the cutting depth. The sleeve is similar to the one on the Hamilton bone drill.

Blackburn Hospital.

CENTRAL FRACTURES OF THE NECK OF THE FEMUR

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THE treatment of central fractures of the neck of the femur has assumed renewed interest because of the newer methods of treatment proposed for the care of this difficult fracture. There is not as yet complete unanimity of opinion as to the advantages of the new method of internal fixation over the old Whitman method. A careful analysis of the two methods, comparing first the end results as expressed in the percentage of solid bony unions obtained and second the hazards and technical difficulties of each method, should help to determine which method will eventually be accepted. We are at present in possession of sufficient data to determine definitely what may be expected from the Whitman method. As yet, there have not been reported a sufficiently large number of cases treated by internal fixation and followed for a sufficiently long period of time to form positive conclusions. It appears justifiable to assume, however, from the data available that a great advance has been made, not only in increasing materially the percentage of unions obtained but in reducing the discomforts and hazards of treatment and in curtailing the period of hospitalization and invalidism.

Whitman Method of Manual Reduction and Cast Immobilization

A great deal of confusion still exists with regard to the results obtained by this method of treatment. This is unquestionably the result of a lack of uniformity in the methods of compiling statistics and explains the otherwise impossible disparity in the published results: the percentage of cases in which bony union is obtained varies from 20 to 90. In other words, for figures to be of value, one must know how the cases were selected, by exactly what method they were treated and upon what criteria the assumption of bony union was determined. It is manifestly unsatisfactory to draw conclusions as regards end results from cases treated only by sand bag or splint immobilization, or to include in a series impacted or incomplete fractures which almost always unite regardless of the method of treatment.

The Whitman method of treatment was carried out in detail as to the reduction and the three month period of cast immobilization was used routinely in all of our cases until about two years ago when the new method of internal fixation was adopted.

Read before the Eighth Annual Assembly of The Southeastern Surgical Congress, in Charlotte, March 8, 9 and 10, 1937.

In 1934 my colleague, Dr. Willis C. Campbell, compiled an analysis of all of our fractures of the neck of the femur. Excluding incomplete or impacted fractures the end results showed 53.3 per cent solid bony union. The mortality was 12 per cent; 34.7 per cent were living with non-union. These figures correspond with the majority of other published results similarly compiled. Even under the most favorable circumstances then, almost one-half of the patients receiving this injury either died as a direct result of it or were permanently incapacitated. Certainly there was need for improvement.

There has been a great deal of controversy regarding the causes of non-union in fractures of the neck of the femur; the more common explanations given may be discussed under the following heads:

1. Improper or incomplete reduction.
2. Insufficient immobilization.
3. Disturbance in the circulation of the head and neck of the femur, resulting in aseptic necrosis of the femoral head.

Improper or Incomplete Reduction: Partial engagement or even simple apposition of the ends of the fragments in fractures of the long bones is generally sufficient to secure bony union but no such margin of safety is present in fractures of the femoral neck. This is in all probability due to two causes. First, after fractures of the femoral neck, the head of the femur is deprived of the major portion of its blood supply. For the head to remain viable and permit bony union, it must be revascularized chiefly from the distal portion of the neck. Accurate apposition of the fracture surfaces is necessary if this re-establishment of the blood supply is to occur. Second, it is well established that union in the femoral neck occurs by means of endosteal callus rather than by periosteal bone formation. This again requires accurate apposition of the fragments.

There is no question but that improper or incomplete reduction is a frequent cause of non-union in cases treated by splints or traction but it cannot be offered as a common cause in those treated by the Whitman method. It is generally agreed that this method effects an accurate apposition of the fractured surfaces. The reliability of this statement is substantiated both by the postreduction roentgenograms in the closed cases and by the visual demonstration which may be obtained in those cases treated by open reduction.

Inclusion of portions of the torn capsule between the fractured surfaces has been advanced by Schmorl and others as another common cause of non-union. An infolding of the capsule in all probability does occur particularly in subcapital fractures, but by manipulation and traction of the hip in flexion as advocated by Leadbetter, Gaenslen and others this complication can usually be obviated.

Insufficient Immobilization: Studies of the circulation of the femoral head and its revascularization following fractures of the femoral neck, combined with the definite evidence of an increased percentage of bony unions following the use of internal fixation, indicate that complete immobilization of accurately apposed fragments may be the essential factor in the whole problem.

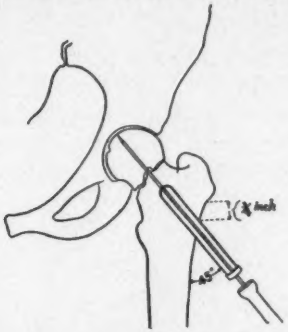

Fig. 1. Drawing showing position for insertion of nail. A point is taken three-fourths of an inch below the origin of the vastus lateralis from the greater trochanter of the femur. At this point the nail is driven so that it forms an angle of 45 degrees with the shaft of the femur.

Experience with cast immobilization has shown that the gross relation of the fragments can be satisfactorily maintained. Regardless of how carefully a cast may be applied it unquestionably permits some movement between the fragments of a fractured hip. This is particularly true in obese patients and in all cases after the cast has become loose. This small amount of shearing movement constantly interrupts nature's effort to revascularize the head by bridging the fracture gap with capillaries from the distal neck fragment. Aseptic necrosis and non-union thus result in many cases where, with proper fixation to favor the repair of the circulatory damage, the blood supply would have been adequate for bony union.

The process of bony union in fractures of the neck of the femur is always slow and in many cases may be delayed for months. Adequate fixation must be continued until this process has become well advanced. Such fixation is impossible by means of a cast or brace immobilization.

Disturbances in the Circulation of the Head and Neck of the Femur: The blood supply to the head and neck of the femur comes from three sources:

1. Ligamentum teres.
2. The nutrient artery and its branches coming in through the cancellous portion of the neck.
3. The capsular arteries.

There has been considerable diversity of opinion as to the relative importance of these three sources, particularly in regard to that supplied through the ligamentum teres. Much anatomic and experimental research, which cannot be reviewed here, has been done to determine this point. The general consensus at the present time is that there is a relatively constant branch entering the head through the ligamentum teres which supplies a small but definite blood supply to the area of the head adjacent to the fovea. Its importance is great in childhood, becomes less after ossification of the capital epiphysis and of decreasing value as age advances. Wolcott states that the vessel may be entirely absent even in children and was not demonstrable in 20 per cent of all the cases he examined.

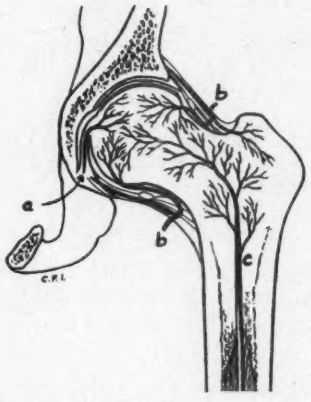

Fig. 2. Schematic drawing showing the circulation of the head and neck of the femur. *A*. Artery of the ligamentum teres. *B*. Capsular arteries. *C*. Nutrient artery.

A large portion of the blood supply, especially of the neck, comes in through the nutrient artery, entering the shaft of the femur below the trochanters and coursing upward through the cancellous bone to enter the neck and head. It penetrates the capital epiphyseal plate even before ossification and anastomoses with branches from the ligamentum teres and capsular arteries.

The most important source of blood supply to the head proper comes in through the capsular arteries. These vessels enter the neck through numerous foramina situated chiefly on the superior and posterior lateral surfaces of the neck about one fourth to three fourths of an inch from the edge of the articular cartilage of the head. They traverse the remaining portion of the neck and penetrate the head where they branch out in a fan shaped pattern to supply the entire head. They also anastomose with the branches of the nutrient artery

and those from the ligamentum teres. A study of the gross anatomy and the roentgenograms of injected specimens demonstrate clearly that under normal conditions the head and neck of the femur have an abundant blood supply.

Fig. 3A. Typical central fracture of the neck of the femur, illustrating method of nailing and end result. Central fracture of the neck of the femur with typical displacement of the fragments.

It is easy to visualize what happens to the blood supply of the head in fractures of the femoral neck. The usual subcapital fracture starts on the superior surface of the neck at a point just distal to the edge of the capital articular cartilage in the area of or just medial to the foramina through which the capsular vessels enter the neck. The fracture line extends a little obliquely downward and outward, completely severing the bony substance of the neck. The result of such a fracture is a severance of almost the entire blood supply to the head; the capsular and nutrient arteries are severed, leaving only the uncertain supply from the ligamentum teres which, as clinical experience and anatomic dissections have demonstrated, is usually inadequate to maintain the viability of the head.

Clinical recognition of the fact that the femoral head undergoes necrosis in a certain number of cases following central fractures of the femoral neck dates back to the time of Sir Ashley Cooper, over one hundred years ago. It has only been in the last 10 years that the earlier clinical observations regarding the process of aseptic necrosis have been placed on an accurate scientific basis and that a complete pathologic description of the process of necrosis with subsequent revascularization and substitution has been given.

Fig. 3B. Anterior posterior view showing fracture reduced with guide pin in position.

Schmorl, Hesse and Bonn were among the earlier investigators in this field. Phemister has recently contributed valuable studies on the general subject of aseptic necrosis. In Santos' comprehensive article (1930), using the data gathered from a study of a series of femoral heads removed at autopsy or operation, he clearly describes the entire pathologic process, correlating the clinical, x-ray and microscopic changes.

Admitting the fact that the Whitman treatment for fractures of the hip provides an accurate method of reduction and fixation which should be adequate for the union of fractures elsewhere in the body,

one must look further for the fundamental cause that produces such a high percentage of non-unions in fractures of the hip.

In 1934 I made a study of a series of fractures of the femoral neck to determine what percentage of femoral heads underwent aseptic necrosis and to determine if possible what relation this process had to the problem of non-union. The results of this study were published in 1936. The series consisted of 100 consecutive cases of complete central fractures of the neck of the femur, ade-

Fig. 3C. Same as B, lateral view.

quately treated by the Whitman method and traced for a period of at least two years. The purpose of this investigation was solely for the study of the process of union in such fractures; all patients with incomplete or impacted fractures and those patients who died during the course of treatment were omitted.

Basing the conclusions on the evidence afforded by the roentgenograms, an effort was made to divide the series into those in which the head remained viable and those in which it became necrotic, and to determine the bearing this had upon union or non-union.

Roentgenologic and histologic studies of the femoral heads removed during reconstruction operations from cases in the series were used to illustrate and confirm the conclusions drawn. A summary of the conclusions is given in the following table:

Solid bony union with viable head	48%
Solid bony union with necrotic head	4%
Non-union with viable head	17%
Non-union with necrotic head	31%

Fig. 3D. Nail in position.

Cases that were progressing to a solid bony union with a living head showed definite characteristics at the end of the routine three months' period of cast immobilization. Roentgenograms showed the normal relative position of the head and neck to have been maintained. The density of the trochanter, neck and head were approximately the same, each having undergone the usual physiologic atrophy that characterizes bone with a normal blood supply.

Later, definite evidence that bony union has taken place is first shown by the reformation of the lines of force extending from the head across the line of fracture into the neck. The final evidence of union is shown by a gradual recalcification of the head, neck and trochanter as function and weight-bearing are resumed.

Non-union with a living head occurred in only 17 per cent of the cases in this series. We must conclude then that the Whitman method provides sufficiently accurate reduction and fixation to permit bony union in the vast majority of cases if the head can be kept alive.

Fig. 3E. Final results one year later.

Improvement in results must depend upon improvement in conditions favoring a repair of the vascular damage and an early revascularization of the head.

Bony union associated with a necrotic head occurred in 4 per cent of these cases. Present evidence indicates that union under such conditions is entirely the result of an outgrowth of living elements

from the distal neck fragment that bridges the fracture line and invades the necrotic tissues of the head. The process of revascularization and repair of the head is usually inadequate to withstand the trauma of weight-bearing and degenerative changes with complete disintegration of the head is the usual outcome when function is resumed.

Fig. 4A. Typical fracture of the neck of the femur with end result. Acute central fracture of the neck of the femur.

Non-union associated with necrotic heads occurred in 31 per cent of the cases in this series. The conclusion that the head was necrotic was based in most cases on a relative contrast in density as shown in the roentgenograms between the head and the distal fragment of the neck and trochanteric region. It is frequently difficult or impossible to draw such distinctions from a single film but when a consecutive series of films taken at intervals of one to two months is available for study one can usually draw definite and reliable conclusions.

The contrast in density is first evidenced as an absorption of lime salts from the distal portion of the neck and trochanteric region. Having an adequate blood supply this portion of the bone undergoes

the normal physiologic atrophy of disuse. The head deprived of its blood supply does not share in this atrophy, retaining approximately the same density that was present at the time of fracture.

In a number of cases in this group the normal anatomic relation between the fragments was maintained for months after immobilization had been removed. The apparent union disintegrated only when direct weight-bearing was resumed. Relying solely on the maintenance of position, one would have been greatly deceived as regards the prognosis in such cases.

Fig. 4B. Fracture reduced with nail in place showing ideal position of the nail in the lower segment of the head and neck.

Microscopic sections were made on nine femoral heads removed at operation, some of which are cases included in this series. Eight of the heads were necrotic and one was viable. The changes seen in these heads corresponded accurately to the roentgenographic appearance and in each case corroborated the preoperative diagnosis as regards the viability of the head. The pathologic changes were the same as those described by Santos and will not be repeated here. With the roentgenologic evidence as a basis for conclusions, it is possible to state from this series that one may expect approximately 35 per cent of the femoral heads to become necrotic following central fractures of the neck of the femur. Treated by the Whitman method 31 per cent will result in non-union.

Treatment of Fractures of the Neck of the Femur by Internal Fixation

The history of attempts to use some type of internal fixation in fractures of the hip dates back to Von Lagenbeck in 1850. Numerous devices and methods have been employed and reported since then, all of which had been discarded until the last few years because of the technical difficulties and almost universal failure attending their use.

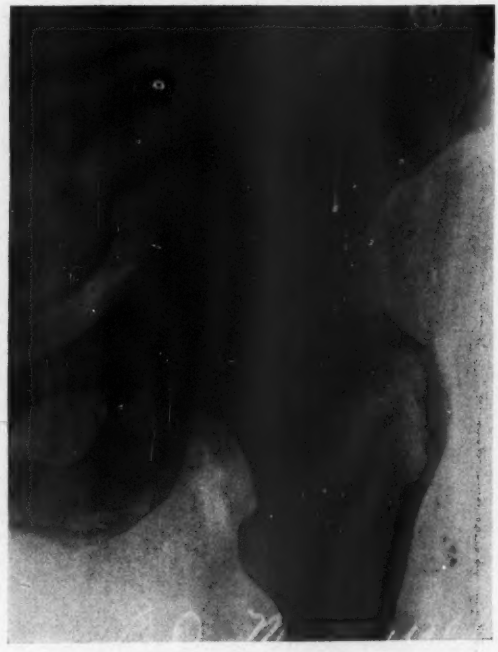

Fig. 4C. End result showing union eight months after fracture.

The failures in the earlier methods were due first to the fact that the nails or screws used were mechanically inadequate to produce complete and prolonged fixations and, second to the fact that there was no accurate x-ray control to insure the proper introduction of the various instruments used. The nails were bulky, displacing and damaging too much bone for the contact surface they provided. The metals were of the corrosive type favoring electrolytic absorption of the adjacent bone. Their shape did not prevent rotation of the head upon the femoral neck. Consequently they rapidly loosened and the fixation was lost before union could occur. Without adequate roentgenologic control they could not be introduced with any degree

of certainty except by open operation, the risks of which were not justified by the poor results obtained from the mechanically inefficient materials used for internal fixation.

The success of the present methods of internal fixation is due to a correction of these two faults. The revival of interest in this method of treating fractures of the hip and the demonstration that it could and did materially improve the very discouraging results obtained by the Whitman method of treatment are due to Smith-Petersen who published the results of this work in 1931. He devised

Fig. 5A. Case illustrating union with a necrotic head. Central fracture neck of the femur.

a three flanged nail which provided a maximum amount of surface contact for cohesive fixation, prevented rotation and displaced a minimum amount of bone. The nail was at first introduced under direct vision by an open exposure of the head and neck of the femur.

In the original 24 cases reported he obtained 75 per cent bony unions with no immediate operative mortality. With the improvement in roentgenologic control the necessity for open exposure has been eliminated simplifying the operative technic and making the procedure applicable to the more difficult surgical risks.

Various modifications of the principle of internal fixation have been introduced since Smith-Petersen's article appeared in 1931. The most important modifications have dealt with internal fixation by means of multiple small pins, the introduction of which is simpler and easier than that of the Smith-Petersen nail. Gaenslen, Austin Moore and others have described the technic for this method of fixation and reported excellent results.

Fig. 5B. Nail in place.

Increased experience in the use of the nail and improvement in the x-ray control, particularly the introduction of the lateral view of the hip, have resulted in the majority of surgeons abandoning the open exposure of the hip in favor of the simpler lateral incision where only a small area of the shaft below the greater trochanter is exposed. The complete open exposure of the hip is disadvantageous for several reasons. The operative risks and mortality are higher. It cannot be accomplished satisfactorily under a local anesthetic. In exposing the hip joint after fractures of the femoral neck unquestionably the circulation to the head and neck of the femur is further

damaged. In the opinion of many this is in direct conflict with what now appears to be the chief advantage of the internal fixation method: early repair of the circulatory damage caused by the fracture, thus creating conditions favorable for revascularization of the femoral head before aseptic necrosis occurs.

While the present operative technic of either the single nail or the multiple pin method of internal fixation is reliable and dependable in the hands of those accustomed to its use, a word of warning

Fig. 5C. Union with necrotic head at the end of 14 months.

should be sounded regarding its general adoption. Internal fixation of fractures of the femoral neck is not a simple procedure and should not be regarded as such. Regardless of the assurances of various authors to the contrary, neither of the methods of internal fixation should be undertaken by the inexperienced or by the experienced except in proper surgical surroundings and with adequate x-ray control in the operating room to guide the accurate insertion of the pins. If these precautions are observed, many failures and much discredit to the method will be avoided.

Operative Technic

The Smith-Petersen nail or the multiple pin method of internal fixation may be performed under either local or general anesthesia. Local anesthesia offers many advantages, particularly as this type of fracture occurs most often in the old and debilitated in whom the least possible disturbance in their physiologic routine is desirable. The time consumed by the entire operative procedure, even under ideal circumstances, will average 40 to 60 minutes. Many of these old people are already toxic and a general anesthetic of this duration can but increase the mortality. No difficulty is encountered either in the exposure of the operative field or the introduction of the nail under local anesthesia. Some difficulty is encountered occasionally with uncooperative or toxic patients in the reduction of the fracture but this can generally be obviated by a little patience on the part of the surgeon or by a few minutes of general anesthesia while the fracture is being reduced. After this the remainder of the procedure can be completed without haste with novocain infiltration.

The advantages of local anesthesia so far outweigh its disadvantages that in time it will become routine. There is some division of opinion as to when the operation should be performed. This depends upon whether the surgeon employs local or general anesthesia. So far as the reduction and healing of the fracture is concerned there is certainly no emergency and the fixation may be delayed as many days as the general condition of the patient demands. Such delay is unquestionably advisable when general anesthesia is to be used but it is rarely necessary with local.

It has been our experience that with the fracture unreduced, it is difficult in many cases to improve the general condition of the patient. Even with the most comfortable type of splinting there is a certain amount of pain on movement and the patients must of necessity be on their backs the greater portion of the time. This discomfort and curtailment of activity is not conducive to improvement in their general condition. It is felt that unless the patient is moribund, early fixation of the hip under local is the first and most important step in the general treatment of the poor surgical risks.

Surgical Technic: The technic for local injection of the fracture and the introduction of the nail or pins has been previously described by other authors and will not be repeated here. The Smith-Petersen nail has been used in all of our cases because mechanically it appears to offer the most reliable means of fixation. Moore and others use the multiple pin method and report equally good results. The latter method is somewhat easier to perform and if time proves that the fixation is equally good, may become the method of choice.

Postoperative Immobilization: This varies with different surgeons from no immobilization and immediate weight-bearing to use of a plaster cast for six or eight weeks. A sensible middle ground is probably the safer course. It does not seem wise to ask too much of the internal fixation unless the patient's general condition prohibits a reasonable period of splint immobilization and recumbency. Such a period of protection for the fracture favors the process of early union and revascularization of the head.

Fig. 6A. Case with solid bony union, illustrating degenerative arthritic changes in the articular surface of the head. Acute fracture.

Our routine has been to immobilize the leg in a Hodgen's splint for a period of four weeks when the position of the fracture is checked by a roentgenogram and, if there has been no change in position of the fracture, the patient is allowed free use of the leg in bed or in a chair for another four weeks. Walking is then begun with the aid of crutches for another month, at the end of which time direct weight-bearing is permitted.

Removal of Internal Fixation: The employment of rustless steel nails or pins permits them to be left in situ for an indefinite period of time. The pins are not removed. The nail is frequently left in

permanently but Smith-Petersen recommends its removal after nine to twelve months and this is the custom followed by most surgeons. The nail can be easily removed under local anesthesia. Some complications, such as pain, aseptic abscesses and arthritic changes in the hip joint have been observed and should be avoided.

Complications: Technical errors, such as faulty reduction of the fracture or improper direction of the guide wire or nail, can be detected and remedied during the operation. Occasionally the nail will strike the head off center as it is driven in, causing the head to rotate into varus or valgus position with reference to the neck. A small amount of valgus is perhaps beneficial as it gives a more direct thrust reducing the shearing action and favoring union. Excessive valgus or any varus is undesirable and should be corrected by reinserting the nail. These displacements can be avoided by using a heavy rigid guide wire. When the nail engages the head poorly, either due to faulty position or to a short nail that does not penetrate the head deeply enough, the head may separate from the nail when strain is put upon it. These errors should not occur but sometimes they do. In atrophic heads, where the normal bone has been replaced by fatty marrow, there is not sufficient solid bone to engage and hold the nail and displacement will occur.

In three of our cases aseptic abscesses developed. They were filled with a large amount of cloudy fluid, all negative on culture and not accompanied by any local or general febrile reaction. They healed promptly after drainage and removal of the nail. Two of the cases went on to solid union and one in which the nail was removed at three months developed a typical non-union.

In one case the major portion of the neck was absorbed, the nail backing out with the head following it. This case eventually obtained solid union with varus deformity.

Aseptic Necrosis of the Femoral Head: Our present series of fractures of the femoral neck treated by internal fixation is not considered large enough nor have enough cases been followed for a sufficient period of time to make a satisfactory study of the question of aseptic necrosis. Using the same standards of roentgenologic comparisons employed in the series treated by the Whitman method, only three cases of aseptic necrosis of the femoral head were found in the internal fixation series of 30 cases suitable for study. In one of these, uncontrollable because of his mental condition, the nail was displaced from the head and non-union developed. The other two obtained solid bony union with a necrotic head, which later developed the typical degenerative and disintegrative changes which were found to be characteristic of the unions with necrotic heads in the Whitman series.

Since adopting the method of internal fixation for fractures of the neck of the femur, we have treated 44 cases by this method. This series is not large enough nor have all the cases been followed long enough to form a positive comparison with those treated by the old method. Experience with the Whitman method has shown that reliable conclusions as to union and function cannot safely be formed for a period of at least two years. In some cases disintegration of the head has developed even after a longer period of time. Fairness of comparison and reliability of statistics demand the same stand-

Fig. 6B. Nail in place.

ards in evaluating the results by internal fixation. Observation of several hundred cases treated by the Whitman method has demonstrated certain characteristics in the process of healing from which one is able to state very accurately that union or non-union is probable long before the two-year period has elapsed. Roentgenologic evidence indicates that the progress of union is definitely more rapid in the cases treated by internal fixation and, in many cases, union appears to be complete at the end of six months. This is probably due to the earlier resumption of function in the joint which hastens the production and calcification of callus and the reformation of the lines of stress across the fracture site.

There are 21 cases in this series that have been observed long enough after removal of the nail to form definite conclusions.

Solid union with viable head	16 or 79%
Solid union with necrotic head	2 or 9%
Non-union	3 or 12%

Two of the non-unions may be attributed to faulty technic. In the more recent group, however, there are two cases in which there is

Fig. 6C. Result at end of two years showing solid bony union. Degenerative and absorptive changes are present in the articular surface of the head. Further destructive changes are to be expected in such cases.

absorption of the neck, varus deformity and probable non-union although the nail was properly inserted.

Of the 44 patients operated upon there have been three deaths during the period of postoperative hospitalization. All were in very old debilitated patients who would probably have died from any minor disturbance in their routine of life.

With the improvement in technic which will come from further experience with the method of internal fixation, it appears that we may expect from 80 to 85 per cent solid bony unions with restoration of a good functional hip. Due to the age period in which most of these fractures occur and the general physical condition of the patients, there will always be a certain number of patients who die as the direct result of the injury. Errors in technic will cause some failures. Thus, we cannot hope to obtain the same results that we do in other types of fractures.

Viewing the two methods as a whole, there can be no doubt that internal fixation of the hip marks a distinct advance in the treatment of this difficult fracture. The percentage of bony unions has been increased from 55 to 80 per cent. The immediate mortality has been reduced. Even if internal fixation did not increase the percentage of bony unions it would be thoroughly justified because of the increased comfort and safety of convalescence. Immobilization of these old people for three months in a plaster cast was necessary in the past because it offered them the only hope for bony union and the avoidance of permanent invalidism. It was an ordeal, however, from which many never entirely recovered.

The period of hospitalization can be reduced when necessary in most instances to four weeks' time. This is a great economic saving for the hospitals treating these cases in charity wards and to the individuals in moderate financial circumstances.

It is interesting to conjecture just what has been added to the Whitman method of treatment by mechanical means of internal fixation. The method of reduction is the same. The nail itself certainly does not in any way stimulate osteogenesis. Whatever influence it may have of itself should theoretically be detrimental to callus formation. Immobilization in the Whitman type of cast provides sufficiently close approximation of the fragments and maintenance of position to insure union in fractures elsewhere in the body. The only difference appears to be a more complete and adequate fixation, preventing the small amount of shearing movement which probably took place in the cast type of immobilization. Complete fixation favors the repair of circulatory damage and earlier revascularization of the femoral head. This is evidenced by the relatively few cases of necrosis of the head seen in cases treated by internal fixation. Opportunity for more rapid bridging of the fracture line by endosteal callus is provided.

CONGENITAL ABNORMALITIES OF THE FEMALE GENITALIA

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IN the machine shop of gestation an orderly process of events produces eventually a finished and perfect unit of humanity known as a baby. When the chronologic sequence of the embryologic assembly line is interrupted by either inefficient workmanship or inadequate material, the finished product reaches the world as an imperfect, substandard, or malformed member of society, and while all congenital abnormalities are unhappy handicaps to their possessors, deflections from the normal in the genitalia are particularly distressing, and especially disqualifying, in that they touch one of the basic impulses of existence, the reproduction of the species.

The incidence of congenital anomalies in the female genitalia is relatively high, being estimated as high as 1 in 700 or 1,000 women. Further, the aid which can be offered by surgery is necessarily limited because of the peculiar function, location, and physiology of this system. The abnormalities vary from the very minor item of simple bars and septa in the vagina to the grotesque and repulsive extreme of hermaphrodism. I shall attempt in this study to deal with those that, while incapacitating to a greater or lesser degree, still offer opportunity for surgical attack.

A very brief outline of the embryology will be all that is necessary, since no great practical help is found in the most intimate and detailed knowledge of this science.

The genitalia begin to be determined at about the ninth week of pregnancy. They come off from the müllerian ducts and ultimately these ducts open into the ventral section of the cloaca, between the wolffian ducts, and terminate at the müllerian eminence. In the female fetus the müllerian ducts undergo further development, and the uterus and vagina are formed from fused sections of the genital cord. The cephalad parts of the cord remain separate, thus forming the fallopian tubes.

The fusion of the müllerian ducts begins in the third month, the septum disappears, and the cavity of the uterus and vagina are formed. It is, of course, immediately obvious that failure of fusion or differentiation of these fetal progenitors ends in some form of disaster: septa, either transverse or longitudinal, in the vagina; a double vagina; atresia; or complete absence.

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Septa are usually easily removed by simple ligation and excision. Double vagina, fortunately exceedingly rare, offers little opportunity for surgical intervention.

Atresias form that group in which best results can be expected from the simplest of surgery. Usually dilatation over a prolonged period of time will suffice, but the last member of this group (complete absence of the vagina) has taxed the ingenuity and skill of the plastic surgeon for many generations.

Various methods have been devised and, roughly, all operative procedures for the construction of an artificial vagina may be classified as: those of the Baldwin type, which employs a section of intestine with which the tunnel between the rectum and the vagina is lined; those of the Kershner-Wagner type, which depend on grafts of the Thierch variety being placed on some foreign body which is thrust into and closely approximated to the walls of the tunnel; the skin-flap type, in which large grafts are lifted from the adjoining integument and reflected into the tunnel, the outstanding example of which is Frank's operation; and the so-called extension of mucosa into the cavity by continuity of growth, as recommended by Wells.

The Baldwin method requires several stages. These include a resection of a loop of small intestine, with the consequent dangers of infection and peritonitis and a primary mortality rate of from 15 to 17 per cent. There is also some danger of the normal secretion from transplanted intestinal mucosa persisting, and irritating the external genitalia in almost unbearable fashion. This operation obviously requires a high degree of skill in the surgeon, an immense amount of courage in the patient, and prolonged and repeated hospitalization. While, in the main, those cases which survive are splendidly successful, the hazard still constitutes a rather effectual barrier to the frequent employment of this type. Indeed, in the few cases in my experience, in which it has seemed to be indicated, I have strongly advised against it.

In the Thiersch graft types, of which the Kershner-Wagner technic is possibly the best known example, the grafts must be stitched, with the raw surface external, on some form of intermediary material, such as a rubber sponge, a condom packed with lamb's wool or cotton, or even on a glass obturator, and the whole pushed firmly into the inter-rectovaginal tunnel. This operation is best done by two surgeons, one making the tunnel while the other secures and sutures the grafts. It is also wise, in this type of operation, to have a hollow core in the rubber sponge, to facilitate drainage, as the grafts must be held in position for from 8 to 12 days. When the pack is removed, and the grafts are found to have taken, repeated dilatations with

hard rubber or glass dilators must be maintained for several months. The literature is full of reports of successful cases done by this method, and indeed this type has given the best results in my small series of six cases. It has the distinct advantage of offering no necessary danger to life, no repeated and prolonged hospitalization, and leaves no bad scars in other locations, such as occurs in the skin-flap graft type.

In this operation fairly large flaps are raised from the most convenient adjacent skin surface, and are of the pedicle type. The flap is reflected into the tunnel which has previously been made, sutured, and held in apposition by a fairly firm pack. After the tenth day the pack is removed and shortly thereafter dilatation begun. Occasionally, since the flaps have to be secured from hair-bearing surfaces, a troublesome condition, due to the continuing of hair growth, develops although it is quite interesting to note the transition from skin to mucosa in a majority of these cases.

Wells and some others have recently reported highly satisfactory results by the continuity of mucosa growth type of treatment. In this technic the tunnel is made and the mucous surface of the labium minor is dissected up and carried as far back as possible into the new-formed cavity, sutured, and lightly packed in position. Firm growth attachment rather quickly occurs in the successful cases, and the mucosa continues to invade deeper and deeper into the cavity which meanwhile must be kept open by repeated dilation and packing.

All of these operations, with the exception of the Baldwin type, are much more successful if a rudimentary pouch is pre-existent in either end of the proposed tract. In other words, if there is a more or less concavation at the external end, the depth of dissection and the amount of new tissue for lining is correspondingly lessened. If, at the internal end, one is fortunate enough to discover an even partial attempt on the part of nature to extend the tract downward, then, because of the great elasticity in this region, much more certain and rapid results are assured.

The uterine anomalies are equally as variable in their extent and variety as are the vaginal malformations, and are classified as:

Uterus Acollis, in which the vaginal portion is absent.

Uterus Bicornis, which is the double horn, and of which there are a multitude of variances.

Uterus Bif-oris, which is a double cervix.

Uterus Bilocularis, or *Bipartitus,* which is the uterus divided into two parts by a septum.

Uterus Cordiformis, heart-shaped, which, after all, is possibly nothing more than a variety of Uterus Bicornis.

Uterus Didelphys, which is two uteri in the same individual.

Uterus Unicornis, in which only one-half is developed, with no adnexa on the undeveloped side.

For these conditions no fixed rule or type of operation can be recommended or applied, largely because they frequently remain undiscovered until symptoms of abnormal gestation disclose them, and further because a restoration of complete or partial function, that is, menstruation and child-bearing, will depend upon the extent and type of the abnormality.

The bicornuate uterus often functions perfectly, both in the menstrual event and in child-bearing. Indeed, there are many recorded cases in which pregnancy in both horns has occurred concurrently, with safe delivery of both babies. As a rule, however, pregnancy occurs in one horn and the other acts as a foreign body, or irritant, in which case it is generally agreed that one member should be removed through abdominal section.

In two cases I have been able to construct a single uterus out of the separate horns, by incising the septum through incision in the fundus, packing the cavity to control bleeding, and then re-suturing the transverse incision in the fundus in reverse fashion. Examination of these cases years later reveals them to be anatomically normal and functionally satisfactory, although, of course, it is the part of wisdom to advise deliveries by cesarean section.

In uterus bif-oris, that is, the double cervix, attack by the vaginal route is sometimes easy and efficient, and results in the conversion of the two openings into one os.

In uterus didelphys, that is, the two uteri with their accompanying tubes and ovaries lying far apart in the same pelvis, my experience has been limited to two cases. One of these women had no true vagina, but only long, tortuous, fibrous canals which emptied into the cavity of the bladder an inch or so on either side of the urethra. When seen by me, such severe pelvic inflammatory disease had resulted from the leaking of urine into the uteri that double hysterectomy was necessary to effect a cure.

The second was discovered at examination after an attempted criminal abortion, and since both uteri emptied normally into a septum-divided vagina, and since function was complete and satisfactory, no further treatment was necessary.

I wish to stress that these are not always hopeless cases, and that much can be done to alleviate the pitiful fate which an unkind nature has imposed upon these unfortunate victims of her caprice.

THE CLINICAL APPLICATION OF THE ASCHHEIM-ZONDEK AND FRIEDMAN TEST

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IN July, 1928, Aschheim and Zondek[64] reported the biologic test now in use for the determination of pregnancy from the urine of pregnant women. At that time they reported a number of cases with a high degree of accuracy. Friedman, using the rabbit as a test animal, recorded his findings in July, 1929, with an equally high degree of efficiency. Many clinics adopted this biologic reaction and although some minor changes have been made in both technics, a correlation of the clinical course of each case with the laboratory test has in no way minimized the accuracy of this biologic reaction. Rossler[53], who had observed it in a terminal case in 1929, cited the marked positive reaction in chorionepithelioma, as did Fels[67], also in the same year. Zondek[51] also in 1929 described the usefulness of the hormonal test in the diagnosis of malignant tumors of the testicles.

These men were pioneers in the evolution of the test and some of the applications of the test; as time goes on limitations and newer uses will appear. At present it is of inestimable value where the gonadotropic hormone is increased. The Wassermann reaction, 95 per cent exact, falls somewhat short of the 95 to 98 per cent preciseness of this newer biologic reaction.

A better understanding of the tests is possible if one will review briefly the physiology involved. There occur normally in the female certain hormones which are markedly increased during pregnancy and on this alone depends the efficacy of the test. These hormones are excreted in the urine; therefore, this medium is utilized for the test. The hormones involved are the estrus-producing hormone and the gonadotropic hormone; the former is markedly increased during the latter months of pregnancy, while the gonadotropic hormone is present in pathologic amounts at the beginning of pregnancy. Therefore, it is this hormone which is of value in the early diagnosis of pregnancy.

The increase of the gonadotropic principle occurs when placenta, decidua, corpus luteum of pregnancy, amniotic fluid or embryonic extract are injected into a test animal. Injection of the hypophyses of pregnant women into infantile mice will have no effect on the ovaries. Therefore, it is problematic whether it is the placenta or

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the pituitary which causes this reaction; present opinion leans toward placental origin. As far as the test is concerned this is of no moment. A positive reaction occurs when the trophoblastic tissue has opened the maternal circulation and the test becomes negative when there is no trophoblastic tissue in connection with the maternal circulation. The gonadotropic hormone reaches its greatest concentration at the fifth month: the earliest reported appearance was 10 days after a fruitful intercourse. The hormone disappears from 2 to 10 days after delivery.

Although the technical procedure can be secured elsewhere it is perhaps wise to give the optimum conditions in a few words. In order that the hormone may be concentrated the patient is warned to consume only 250 c.c. of fluid from 4 p. m. of the afternoon preceding the collection of the morning specimen. Fifteen cubic centimeters of urine are injected in the marginal ear vein of a female rabbit 4 or 5 months old, or one who has had one litter and has been segregated for 3 weeks; this precaution is necessary because the rabbit ovulates when it copulates. If immature white mice are used, 6 doses of 0.5 c.c. of urine are injected subcutaneously; 3 doses are injected the first day and 3 doses the second. The mice are 3 weeks old and weigh 6 Gm.; at 6 weeks the mice go into estrus and, therefore, older mice cannot be used. If the urine is toxic, it can be detoxified with ethyl ether or sulphosalicylic acid (1 Gm. to 25 c.c. of urine, let stand 30 minutes, shake, filter and neutralize with soda bicarbonate).

The Aschheim-Zondek test has three reactions. Reaction 1 is follicle maturation (cumulus oophorus) indicative of Prolan "A". Reaction 2 is hemorrhage in the follicles, and reaction 3 is the formation of corpora lutea with imprisonment of the ovum. Reactions 2 and 3 are indicative of pregnancy.

A positive Friedman test is diagnosed by the presence of fresh corpora lutea or bulging corpora hemorrhagica; they are not to be confused with the corpora lutea of pregnancy and pseudo-pregnancy.

The mice are sacrificed at the end of 96 hours, while the rabbits are operated on at the end of 48 hours: if an emergency exist the rabbits may be opened in 24 hours. Since 2 to 4 per cent of rabbits are refractory to the test and there are some individuals who have a low hormone threshold, one negative reaction, whether of the Aschheim-Zondek or Friedman methods, is never a criterion for the diagnosis of non-pregnancy. Goldberger[13] et al., using two rabbits for each test, obtained a high accuracy in diagnosis, having only 0.55 per cent false negative and 0.09 per cent false positives in 1,093 tests. Weiser[6] observed that when a negative result was obtained up to the fourth month, these cases ended in prematurity.

The indications for the test are:

1. Early diagnosis of pregnancy.

2. Where interruption of pregnancy is imperative as in severe diabetes, tuberculosis, renal and cardiac disease; the pregnancy can thus be terminated earlier.

3. Differential diagnosis of pelvic tumors and pregnancy. Diagnosis of fibroids with pregnancy.

4. As an index of the complete removal of the products of conception.

5. Where there is a question of diagnosis in acute abdominal conditions in which ectopic gestation is involved.

6. Diagnosis, prognosis and treatment of hydatidiform mole and chorion-epithelioma.

7. Diagnosis, prognosis and treatment of teratoma testis.

8. Diagnosis of some pituitary tumors.

9. Medico-legal.

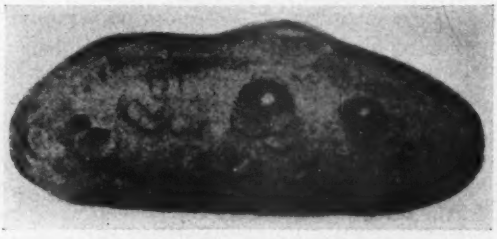

Fig. 1. Ovary of a rabbit 6 months old showing follicle cysts.

In discussing the results of 550 cases in which there was an accurate reaction in 96 per cent, an interpretation of the clinical findings will be made. The first three indications are self-explanatory, but a note of caution should be sounded. Since there is an inherent error in the test itself, one negative reaction does not rule out pregnancy; the test should be repeated if any operative procedure on the pelvic organs is contemplated. There have been instances in which a fetus was removed by supravaginal hysterectomy after one negative test; a second specimen collected immediately after operation gave a positive reaction.

In incomplete abortion and in missed abortion, these tests will become negative when there is no trophoblastic tissue or its successor, chorionic villi, invading the maternal structure; however, neither the Aschheim-Zondek nor the Friedman reaction will give an index as to the viability of the fetus. Emphasis should again be placed on the fact that one negative reaction is never an indication for emptying the uterus.

As a differential diagnostic procedure in ectopic pregnancy the test is of distinct value. A positive reaction is diagnostic but a negative test does not disprove the presence of ectopic gestation. Wilson and Corner[11] have observed that the Friedman test was negative in 12 cases of ectopic pregnancy where there was no living chorionic villi attached or where "ghosts of villi" were present. This service has an 80 per cent positive reaction in ectopic pregnancy. Aschheim is of the opinion that a negative test in ectopic gestation is an indication that the chorionic villi have ceased to invade the maternal circulation and that, therefore, the danger of hemorrhage is obviated. It is conceivable that a tubal abortion would give a negative reaction but that a few days later after a secondary abdominal implantation the test might become positive. As valuable as it is, the test should not overshadow clinical findings in this condition.

The use of the gonadotropic hormone tests in the diagnosis, prognosis and treatment of hydatidiform mole and chorionepithelioma is of great worth. Normally there appears in the urine of pregnant women 10 mouse units per cubic centimeter (a mouse unit is the smallest amount of urine which when injected in an immature mouse will give a positive Aschheim-Zondek reaction). Using the Friedman modification Dabney and Dabney[18] obtained a positive reaction with as low as 0.6 c.c. in the normal pregnant women, while Schoeneck[54] obtained a positive with 0.05 c.c. in normal pregnancy. When Schoeneck used this same reaction quantitatively he obtained a positive in a hydatid mole with 0.0063 c.c. to 5 c.c. of urine and remarked that the larger amounts were required in moles undergoing degeneration. Since there is such an overlapping between normal pregnancy and hydatid mole as to the amount of urine used, it is doubtful if the rabbit is a satisfactory test animal for the quantitative gonadotropic hormone test. The Aschheim-Zondek test with its three degrees of variation offers a much better quantitative reaction. Employing infantile female mice Borras[24] gives 50,000 mouse units per 1,000 c.c. as the upper levels of normal pregnancy; while Aschheim quotes 100,000 mouse units as the upper limit and cautions that twins and polyhydramnios may give this amount. Hirst reports a case of twins giving 100,000 mouse units per liter of urine. Leventhal and Saphir[38] diagnose chorionepithelioma and hydatid mole on the appearance of 33,000 to 100,000 mouse units per liter of urine.

Approaching the problem of hydatid mole and chorionepithelioma from the clinical side while utilizing the gonadotropic hormone tests one is confronted with the knowledge that the test is an indispensable adjunct in diagnosis and treatment, yet he should not relegate his clinical judgment to the laboratory, for as was pointed out

twins and polyhydramnios also cause an increased output of hormone. In the absence of clinical symptoms, a laboratory diagnosis of hydatid mole or chorionepithelioma should never be an indication for emptying the uterus or employing more radical surgical procedures. On the other hand the presence of symptoms and microscopic evidence of these two conditions should not deter one from operating, for it has never been proven that a negative hormone reaction of pregnancy denotes the absence of hydatid mole or chorionepithelioma; Schumann in discussing Kimbrough's[3] paper cites such a case. Fahlbusch[54], however, refused to operate in the face of a negative prolan test *which had been repeated* in spite of strong microscopic evidence of malignancy.

Fig. 2. Ovary of a mature rabbit showing corpora hemorrhagica.

Mathieu and Palmer[20] report a case which was free of symptoms but gave a quantitative test indicative of chorionepithelioma; operation revealed that the growth had penetrated the myometrium; Beattie[56] reports a similar case. Another point of interest cited by Mazer and Ediken[27] was 2 cases of chorionepithelioma who had received radium application and in whom the symptoms were marked. The Aschheim-Zondek test was positive. They value the test highly, remarking that curettage does not show the extent of invasion and necrosis of myometrium, and that increasing quantitative differences is pathognomonic of chorionepithelioma. After x-ray treatment to metastases found in the lungs, the Aschheim-Zondek reaction became negative (Schultze-Rhonof[55]); the metastasis was discovered because the test was positive after a panhysterectomy for chorionepithelioma. A positive test in this malignancy should become negative four months after operation, but an increasing quantitative test speaks for metastases.

Nason[32] reported a metastatic chorionepithelioma to the lungs 25 months after the removal of hydatid mole by supravaginal hys-

terectomy. Schumann[60] cites a case of chorionepithelioma 31 years after the last pregnancy. Kimbrough[3] states that the increasing concentration of prolan in urine longer than two weeks after termination of pregnancy, either premature or at term, or longer than two months following the expulsion of a mole, is strongly indicative of chorionepithelioma; also that the reappearance of a positive test following one or more negative tests is pathognomonic of a malignant degeneration if an interim pregnancy can be ruled out. Mathieu and Palmer[20] give one year as the time limit for following hydatid mole by the Aschheim-Zondek test.

Davy and Sevringhaus[4] record their reactions in hydatid mole and chorionepithelioma as false positives. In this report, the two cases of chorionepithelioma and three cases of hydatid mole are listed as correct positives.

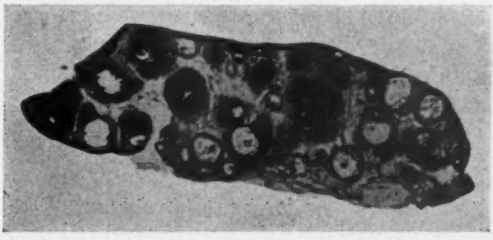

Fig. 3. Photomicrograph showing corpora lutea and corpora hemorrhagica with retained ova.

The use of the Aschheim-Zondek reaction in the diagnosis, prognosis and treatment of teratoma testis is also a marked advance. Zondek utilized this reaction in 1929 and since that time Ferguson[39, 46] had brought the test to such a high degree of efficiency that he classifies the type of growth in the testis by the initial quantitative Prolan A output before treatment. The radio-sensitivity of the tumor is gauged by the amount of Prolan A after x-ray treatment. Herger and Thibeaudeau[47] and Main and Leonard[43] corroborate his findings, while Entwisle and Hepp[37] report one case with positive hormonal tests.

McCullagh and Cuyler[2] report 946 tests in selected non-pregnant individuals and found 209 positive reactions. In 131 cases a clinical diagnosis of pituitary disease was made and excessive amounts of urinary prolan were found in 50 cases. In the 15 cases they studied, 7 cases of proven pituitary tumor gave negative reactions and 8 cases gave positive reactions; they do not record the use of the Aschheim-Zondek reaction but do speak of the Friedman test. The results might have been different if the Aschheim-Zondek had been

used. Treatment with x-ray to the pituitary resulted in a diminution of urinary prolan.

Other investigators are finding new uses for the test. Schoeneck has pointed out the fact that in excessive vomiting of pregnancy smaller amounts of urine are required for a positive reaction in the test animal and he has shown that it was not the specific gravity of urine that made the difference. Perhaps further investigation along these lines will bring a better understanding of hyperemesis gravidarium. Potter[21], on the other hand, has shown that habitual aborters show only reaction I in the Aschheim-Zondek test, but she concludes by her experiments that there is no relation between the amount of Prolan A excreted and the continuance of the pregnancy to term.

Allen mentions the fact that prenatal determination of sex is possible by injecting urine into the vein of a male rabbit; a male fetus causes no hypertrophy of the testes but a female fetus will cause hypertrophy.

Discussion of False Positives and False Negatives

In this series a false positive was encountered in ovarian cyst (retention type), pituitary tumor, menopause, hypernephroma of the ovary, granulosal cell tumor of the ovary and carcinoma of the fundus of the uterus. Aschheim lists early and late menopause, castrated women, severe primary or secondary amenorrhea, Graves disease and genital carcinoma; these, however, gave reaction I only and it was his impression that the cases of genital carcinoma were in the menopause and that the reaction was due to this condition and not to the carcinoma. Ziserman[10] gives the climacteric, primary ovarian hypofunction, hyperthyroidism, ovarian cyst, malignancy and organotherapy as causes of false positives. In the climacteric there is decreased ovarian activity which allows the pituitary an increased activity, thereby accounting for the positive test. A patient receiving organotherapy, pituitrin or x-ray to ovaries or pituitary should not have hormonal tests for pregnancy at that time.

False negative reactions occurred twelve times and were attributed to the use of immature rabbits, pregnancy before the fifth week, ectopic pregnancy and in one case to unknown cause. The latter case gave a repeated negative test at the sixth month though the patient was delivered of a normal full term baby.

Summary

I. Five hundred and fifty gonadotropic hormone reactions are reported.

2. The test was correct in 96 per cent of cases.

3. Indications for the test are given with an interpretation of the clinical and laboratory finding.

4. The false negatives and false positive reactions are recorded.

Total number of Friedman Tests..... 550

False positives	9	3.81%
False negatives	12	
Correct positives	225	96.18%
Correct negatives	304	
False negatives		12
Immature rabbit	4	
Pregnancy before 5th week	3	
Ectopic pregnancy	4	
Unknown pathology (neg. at 6 mo.)	1	
False positives		9
Ovarian cysts (retention)	3	
Pituitary tumor	1	
Menopause	2	
Hypernephroma ovary	1	
Granulosal cells tumor	1	
Carcinoma uterus	1	

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INJURIES TO THE BONES OF THE ELBOW

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FRACTURES in the region of the elbow and their care comprise one of the most important phases of traumatic surgery. Second in frequency only to fractures of the wrist, there is no part of the bony skeleton in which injury is followed more frequently by some interference with normal function. Due to the fact that a great many of these injuries occur in the working class any resultant permanent disability becomes a serious economic loss.

The fact that three separate and distinct bones are involved in the construction of the elbow joint accounts for a multitudinous array of fractures. A review of certain anatomic considerations is important to the complete realization of this subject. The shaft of the humerus broadens in its lower third and the lateral and mesial borders flare out sharply to form the condyles. On each condyle there is a sharp projecting knob called the epicondyle. The one on the mesial side is much more prominent than that on the lateral side and is grooved behind for the ulnar nerve. The mesial condyle is larger than the lateral and is called the trochlea. It articulates with the sigmoid cavity in the olecranon process of the ulna. The smaller lateral condyle is the capitellum and articulates with the head of the radius. On the anterior face of the humerus just above the trochlea is a depression called the coronoid fossa which receives the coronoid process in flexion. Posteriorly at about the same level is the olecranon fossa which receives in complete extension the olecranon process. At this point the bone is very thin and constitutes an important predisposition to fracture. The head of the radius presents a constricted cylindrical appearance and is held firmly in apposition to both the ulna and humerus with which it articulates by means of the orbicular ligament. The angle formed at the elbow, when in complete extension, is approximately 165 degrees with the angle open outward and is called the carrying angle. At birth the lower end of the humerus is cartilaginous and complete ossification does not take place until the eighteenth year. Hence, fracture before that age is much more frequent than after ossification is complete. This fact must also be kept in mind in radiologic studies of any elbow in which fracture is suspected. In young patients, particularly those before the age of 10, x-ray studies of the elbow are altogether inadequate to make an accurate diagnosis of fracture and a great deal of reliance must be placed on the clinical manifestations accom-

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panying the injury. Moreover, not infrequently has an un-united center of ossification been called a fracture. This is particularly true of the capitellum whose center unites with the shaft about the seventeenth year.

Fig. 1. Right arm showing practically normal carrying angle.

Fractures in the region of the elbow then must be differentiated as follows:

A. Fractures of the lower end of the humerus.
B. Fractures of the upper end of the ulna.
C. Fractures of the upper end of the radius.

Fractures of the lower end of the humerus present several distinct types:

1. Supracondylar fracture.
2. Transverse diacondylar fracture.
3. Fracture of a single condyle.
4. Intercondyloid or "T" fracture.
5. Fracture of an epicondyle.
6. Separation of an epiphysis.

The supracondylar type of fracture is found frequently in children and this together with the diacondylar type is produced by a fall on the outstretched hand with the elbow hyperextended. The characteristic deformity is a backward displacement of the lower fragment. Fracture of a single condyle or epicondyle is usually produced by a direct blow on the elbow. The intercondyloid fracture is essentially an injury in adult life. It is frequently accompanied by con-

siderable comminution and marked displacement of the fragments. It may also be seen not uncommonly in combination with injury to the upper end of the radius and ulna and in such cases is frequently compound. This is the injury usually sustained by motorists to the left elbow when that protruding member is struck by a closely passing vehicle such as the overhang of a truck.

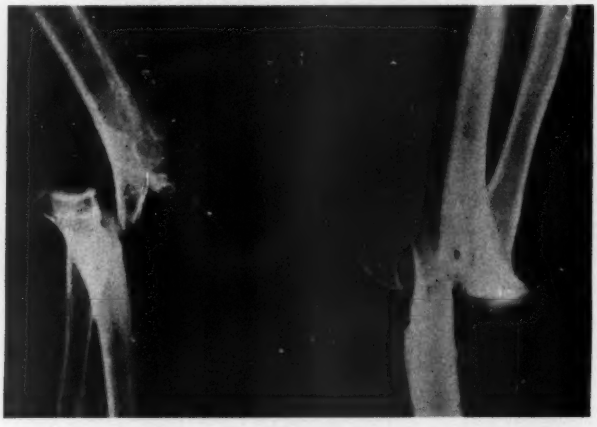

Fig. 2. Compound, communited intercondyloid fracture of humerus.

In most fractures of the lower end of the humerus essentially the same treatment is indicated. That is: adequate reduction under anesthesia and fixation in acute flexion. By adequate reduction is meant not simply putting the arm into acute flexion but actual manipulation to secure the proper relation between the short lower fragment and the upper fragment. Not infrequently the lower fragment remains rotated internally which, if allowed to remain, not only interferes with complete flexion and extension, but impairs the carrying angle. The position of acute flexion has been adequately described by the late Sir Robert Jones. This position splints the fracture and holds the fragments in their corrected position better than any other. The post-reduction treatment is extremely important because it alone may determine the extent to which any given injured elbow may recover function. Every case must be treated individually depending on the type and severity of the injury but in general, active exercises are begun on the tenth day and the range of motion gradually increased up to the point of tolerance. Various measures of physical therapy, such as heat, massage, etc., are of great value. Later on when union is firmer, weight supporting to stretch the resisting tissues is indicated. For this purpose, a pail of sand which can be graduated as to weight makes a convenient article to use.

Forcible passive exercises sufficient to tear the tissues and produce hemorrhage are contraindicated.

Fig. 3. Unsatisfactory with internal rotation of lower fragment.

In those cases of "T" fracture in which there is a great deal of separation of the fragments or excessive comminution of the articular surface, more radical treatment should be used early. Here a

Fig. 4. Adequate reduction of fracture shown in Fig. 3. . .

complete resection of the lower end of the humerus or of the entire elbow joint, where the radius and ulna are also involved, may be done as it promises less disability than under the more conservative treatment. This procedure is especially indicated in cases of compound injuries with marked fragmentation of the joint surfaces and

introduction of dirt and other infected foreign substances into the wound. A thorough debridement of these wounds is done and all loose fragments of potentially infected bone removed. The wound

Fig. 5. End results after resection of joint following severe compound fracture. Stable joint with 85% motion.

Fig. 6. Joint shown in Fig. 5 in relaxed extension.

cavity is irrigated with normal saline and the wound packed with sterile vaseline gauze. The arm is then placed in a right angle splint with gentle traction applied to the forearm in two directions; forward and outward. Active and passive motion is begun early and the vaseline pack is gradually removed allowing the cavity to

obliterate itself. If necessary, repeated packings are done using the same technic as described by Orr for compound fractures. Usually, a fairly stable movable joint is the result which for all practical purposes is much more desirable than an ankylosed elbow. In my experience, there has been less tendency for this type of elbow to undergo periodic painful inflammatory exacerbations than in those cases in which the initial treatment was less radical.

Fig. 7. Joint in Fig. 5 in almost normal flexion.

Fractures of the upper end of the ulna comprise:

1. Fracture of the coronoid process.
2. Fracture of the olecranon.

Fracture of the coronoid process rarely occurs alone but is the usual accompaniment of a posterior dislocation of the elbow. Reduction is readily obtained by placing the elbow in acute flexion.

Fracture of the olecranon may be produced by a direct blow or a fall on the semi-flexed arm. Due in part to the blow and in part to the action of the tense triceps muscle, the tendon of which is attached to the tip of the olecranon, the proximal fragment is oftentimes widely separated from the shaft.

Treatment in this case reverses the position of choice in all other fractures of the elbow inasmuch as complete extension is indicated. If adequate apposition of the fractured surfaces cannot be procured by the closed method, open reduction should be resorted to and the fragments fastened with kangaroo tendon or some other resistant suture.

Fractures of the upper end of the radius may be differentiated into those involving the radial head and those involving the neck. They are much more common in adults than in children and are usually the result of a force transmitted through the shaft of the radius forcing the head against the capitellum. If little or no displacement of the fragments exists, the elbow should be flexed acutely in complete supination. If, however, any degree of displacement, particularly of fragments of the radial head, is present a resection of the head of the radius should be done without delay and active motion established as soon thereafter as cessation of local reaction will permit.

Success in the treatment of fractures about the elbow as well as any other part of the skeleton depends on the observation of certain anatomic and mechanical principles. Failure to observe the characteristic displacements and the mechanics of adequate reduction as well as the principles of post reduction treatment will most certainly bring disastrous results.

ELECTROSURGERY

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IT seldom is possible for the general surgeon to devote sufficient time to detailed study of a complicated electric instrument. The surgeon's chief concern is not the construction of an electrosurgical instrument but its surgical possibilities.

Electrosurgery may be considered under three headings: (1) the time-honored electrocautery, (2) surgical ionization which is not often used now, and (3) surgical diathermy which is most important. The electrocautery needs little description since the principles underlying its use are well known to all surgeons.

While electric ionization plays a certain rôle in the electrosurgical treatment of superficial lesions and in epilation, it is probably not of great interest to the general surgeon.

Few articles are written today concerning the uses of electrocautery and electric ionization. The literature is filled, however, with articles concerning the use of surgical diathermy. The confusion surrounding surgical diathermy probably results from failure to recognize the fact that it is entirely different from electrocautery in its mode of action and in its effect. The electrocautery destroys tissue by conduction of heat from the hot applicator to the tissue. Surgical diathermy, on the other hand, destroys tissue because the tissue offers resistance to the flow of the current and thus produces varying degrees of endogenous heating and even actual distintegration. While the instrument itself is a good conductor and remains cold, the tissues offering resistance to the flow of current are heated. The application of high frequency currents is so often regarded as a form of cauterization that this explanation seems essential. Not only are the cautery and surgical diathermy entirely different, but the accuracy of control when high frequency currents are used is so much more delicate than the cautery that there is no comparison.

There are several types of surgical application of the high frequency currents, that is, monoterminal surgical diathermy (fulguration, desiccation), biterminal diathermy (coagulation) and the cutting current. According to Kovács, fulguration is a painful and

inefficient method, as the rapid carbonization by sparks prevents deep penetration.

According to Cumberbatch and Harmer, there appears to be some uncertainty as to the nature of the treatment called "fulguration" by some writers and "electrodesiccation" by others. Occasionally, it is also confused with diathermic coagulation. When fulguration is used the tissue is destroyed by heat derived from sparks. The heat does not penetrate far below the surface. The fluids of the tissue are evaporated, and a dry residue is left. When electrocoagulation is used the lethal effect is the result of the heat which the current generates in passing through the tissue and overcoming its resistance. The tissue is heated en masse until it coagulates. Electrodesiccation is unsuitable for the treatment of large masses or those extending more than about 1 cm. below the surface.

Electrocoagulation is applicable to the destruction of large malignant growths. The entire growth may be coagulated and removed as an inert mass. The blood vessels and lymphatics in the surrounding tissues will be sealed by thrombosis; this prevents hemorrhage and shock and also tends to prevent the dissemination of malignant cells.

A modified method of electrocoagulation is produced by the employment of two electrodes, two needles or two prongs of a clamp. With this technic coagulation occurs in the small region between these electrodes.

The high frequency currents used in fulguration, electrodesiccation and electrocoagulation are all damped currents, that is, oscillating currents in which the amplitude of successive alternations becomes less and less until it finally dies away.

Investigations by Keysser and by Nieden demonstrated that following the usual technic of electrocoagulation there are two definite zones in the coagulated tissue. The inner zone is blanched and the histologic examination shows the typical coagulation necrosis of ordinary skin burns. This zone passes over into an ill defined outer zone of shriveled cells and dilated vessels. Nieden also pointed out that deep coagulation, even in the inner zone of necrosis, is always uneven according to the variation of the resistance in different tissues and that the resulting injury is therefore unpredictable.

The most recent use of the high frequency current is for cutting tissues. Many terms have been applied to this method, such as "radio knife," "electrothermic knife," "Bovie knife," "endothermic knife" and "acusector." With this method a needle point or thin knife is connected to one terminal and a large dispersing electrode

is connected to the other terminal of the high frequency apparatus. The tissues are rapidly or slowly cut, the needle or knife divides the tissue "like butter." The histologic effect also occurs in two zones. The inner zone consists of molecular disruption; the outer zone shows elongation of the tissue cells and slight coagulation. The "sector" (cutting needle) coagulates the wound so slightly that there may be only slight interference with healing, while there is usually marked diminution in capillary oozing.

Lowry said that "there have been two distinct schools in electrosurgery, the cutting school and the cooking school." However, in general electrosurgery both "cooking" and "cutting" currents are essential.

Kelly and Ward said that the demand for electrosurgery had arisen because of the inherent imperfection in operative technic. The necessity of ligating bleeding points, the dissemination of infection or malignancy, and the inability to secure adequate hemostasis in inaccessible parts of the wound are for the most part obviated by the use of electrosurgery. Only those inexperienced in the use of high frequency currents encounter much difficulty. Kelly and Ward also said that the slow acceptance of electrosurgery is probably due partly to the fact that the apparatus is still in the stage of development and partly to lack of persistence in technic.

The indications for electrosurgery according to the rather voluminous literature are many and play a rather definite rôle in all types of surgery. German authors[15] reported 250 cases in which electrosurgery was used and found very satisfactory. They reported that amputation of the breast for cancer was the most favored field for this method. They also said that outstanding results can be obtained with the use of high frequency currents in operations on the thorax, especially resection of a rib or thorocoplasty, even in the presence of pulmonary tuberculosis or empyemic cavities. Heymann found the procedure effective in incision and enucleation of furuncles, carbuncles and in the elimination of extensive purulent foci. He pointed out that the layer of coagulated protein formed on the cut surface constituted a natural bulwark against the spreading of pyogenic organisms.

Scott[22] said that in the use of the loop cautery knife in more than 1,500 operations for malignancy there was no other alternative than the conclusion that at present it is the safest and most dependable means of eliminating local recurrence of malignancy after surgical removal.

Daniel, Lamblin and David summarized the advantages of the use of surgical coagulation which they believed to be the method of

choice in the treatment of cutaneous cancers. They mentioned improved cosmetic results, greater simplicity of technic, less hemorrhage and greater rapidity of operation. They further said that they had never seen a recurrence in cases in which lesions were treated solely by this method. It was stated that high frequency currents were of value in various other conditions of the skin, such as lupus vulgaris, tattoos, tuberculosis, varicosities of the face, chancroidal buboes and angiomas.

Electrosurgery has been used extensively by Cushing, Sachs and Davis since 1931 in the treatment of certain intracranial tumors, particularly meningiomas and gliomas. Sachs said that tumors of the brain which heretofore had been considered inoperable could be removed by this method. Adson now uses the high frequency current routinely for hemostasis in all types of neurosurgery.

Electrosurgery is used to advantage in the treatment of diseases of the ear, nose and throat. Hesse was of the opinion that electrosurgery is of special value in the treatment of malignant diseases of the nose and throat, particularly small malignant growths of the larynx and maxillary sinus. It is the consensus of opinion of those experienced in this field that electrocoagulation of tonsils should be used only in exceptional cases, as in cases in which there is a history of advanced tuberculosis, exophthalmic goiter, or myocardial degeneration, and that in such cases the method is safe only in the hands of trained otolaryngologists.

A number of authors (Mock, Tinker, Jackson, and Heymann) enthusiastically advocated the use of surgical diathermy in thyroid operations, particularly in operations for malignant tumors of the thyroid and exophthalmic goiters. They said that its advantages are that hemorrhage is lessened by sealing capillaries and small vessels. The method also is an important factor in preventing the spread of malignant cells or thyroid toxins into the blood stream and reduces the time of operation by a fourth or more. It tends to produce good healing by avoiding the filling of the wound by blood serum, by electric destruction of bacteria and by avoiding the use of catgut, silk, or other foreign materials in the wound.

The use of high frequency currents in transurethral operations, according to Caulk and Patton, appears to possess natural inherent dangers. These authors said that high frequency currents seem to create certain postoperative complications definitely attributable to the effect of the currents. It has been determined that these effects result from heat and that electrolysis and destruction of the cells by electric vibration play an insignificant rôle. This is not true when the actual cautery is used, because the heat does not penetrate to

any appreciable depth; its only heating effect results from conduction. The authors reported that, in a series of 15,000 transurethral operations on the prostate gland, postoperative hemorrhage occurred twice as often when high frequency current was used as it did when the punch operation was performed. Permanent incontinence of urine occurred in a large percentage of cases following resection but only once following the use of the punch technic. Urinary sepsis was noted two and a half times as often after resection as it was after the use of the punch technic. Regarding the type of machine, postoperative hemorrhage and permanent incontinence of urine occurred three to three and a half times as frequently when tube machines were used as compared to the incidence when spark gap machines were used.

In regard to renal surgery, Scott[23] reported the use of the electrosurgical scalpel chiefly for the removal of calculi and the resection of the lower pole of the kidney. He found that this method greatly decreased and often entirely controlled bleeding. The clamping of the vascular pedicle was often not necessary. In removing portions of the kidney, less bleeding was encountered, fewer sutures were necessary than with scalpel technic and therefore there was less loss of renal function. In the hands of such men as Kelly and Ward, at least, high frequency currents have proved their value in gynecologic operations. These surgeons used the method in laparotomies, in the treatment of endocervicitis and in the eradication of Bartholin's abscesses.

Peterson and Frank reported the satisfactory closure of vesicovaginal and rectovaginal fistulas by monoterminal diathermy currents. The epithelium around the fistulous tract was destroyed by enough current to cause a whitening of the epithelium of the bladder but care was taken not to destroy the underlying tissues. Rectovaginal fistulas may be closed by sparking around the circumference of the opening of the vaginal end of the fistulous tract. Frank said that by this means some of the most stubborn types of fistulas are readily closed.

In rectal carcinomas and other proctologic conditions, electrosurgical biopsies are important. The Strausses reported the use of surgical diathermy with excellent results in 73 cases of rectal carcinoma observed in seven years. They were particularly interested in the procedure since it was the first in which local destruction produced clinically, at least, a permanent systemic effect. It seemed to destroy the toxins which were absorbed from the carcinomatous tissue. Fansler expressed the opinion that electrocoagulation of rectal carcinomas had distinct advantages over other methods of treatment,

because it could be used in a majority of cases of rectal carcinoma in which radium might be indicated. Another advantage, he said, was the absence of prolonged pain or toxic symptoms which sometimes followed radium therapy. He advocated electrocoagulation of early lesions, preferably of low grade malignancies, in cases in which old age or other physical impairment would contraindicate radical abdominal or perineal methods of excision. He also advised the use of this method in cases in which the lesions are inoperable, particularly the cases in which large growths are producing distressing rectal symptoms and in cases in which there is partial or complete obstruction as the result of a large rectal growth.

The anesthetic used in electrosurgery, of course, must be of the nonexplosive type. Mock said that ethylene should never be used and that ether and nitrous oxide should never be used in combination, but that ether could be used safely provided a wet blanket was used to separate the mask from the field of operation. Local anesthetics may be used but care must be taken in operating on the infiltrated region because of the difference of conductivity of the infiltrated tissue. It also should be remembered that twitchings occur when the muscle is touched with a high frequency cutting needle or knife when a local anesthetic has been used.

B. C. Crowell, in a report on research on electrosurgery done under the auspices of the American College of Surgeons, summarized the general results obtained in 913 cases by 196 surgeons in 33 states. The report stated that there was, in general, less postoperative pain than there was when a scalpel had been used, the incidence of secondary abscesses was decreased, there was a slight delay in healing time of skin wounds and secondary hemorrhage was decreased.

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THE USE OF PREPUCE TO EPITHELIALIZE TRACT IN THE TREATMENT OF IMPERFORATE ANUS

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THE smaller of twin boys born on March 19, 1934, two days later was discovered to have an imperforate anus. He was admitted to the Georgia Baptist Hospital on the 22nd. Except for the absence of an external opening of the large bowel, he was well developed, but he was poorly nourished and somewhat dehydrated, weighing 4 pounds 6 ounces.

After saline and dextrose solution had been administered by hypodermoclysis, operation was undertaken under local anesthesia. With the patient held in the lithotomy position, a small amount of 0.5 per cent procaine was injected into the skin and subcutaneous tissues at a point in the median line between the buttocks back of the scrotum where the anus should have been. An incision 1.5 cm. was made through the skin and with a small sharp-pointed hemostatic forceps blunt dissection was used to separate the subcutaneous fat and muscles, the skin being retracted with small right angle retractors. At a depth of 2.5 cm. was encountered the terminal end of the colon, rounded and dark in appearance. An aspirating needle was inserted and meconium withdrawn. The intestine was then punctured and meconium escaped freely. A large rubber catheter well lubricated with vaseline was inserted, and the colon irrigated with warm saline. The tract was packed loosely with vaselined gauze for twelve hours, then the packing was removed and the colon irrigated and repacked. This was repeated every twelve hours for several days and then a well lubricated rubber tube with safety pins through the end was inserted and kept in position with gauze dressings. The little patient was taking nourishment satisfactorily and his artificial anus was functioning well.

Textbooks on surgery describe imperforate anus and its treatment up to this point, but none of them mentions permanent epithelialization of the tract following operation. The question therefore arose how to make the anus permanent and prevent closure by scar tissue. Several methods of skin graft were considered and Dr. W. S. Dorough suggested the use of the patient's foreskin.

On March 31, nine days after the primary operation, the patient was circumcised. The prepuce was incised lengthwise, and the skin and mucous membrane surfaces separated. This rectangular piece of epithelial tissue was then placed with the raw surface outward around a short section of rubber tube of proper size to fit the granu-

lating sinus: it was tied in place with three strands of No. 000 plain catgut. After irrigating the colon, the graft-covered tube was inserted into the sinus with the mucous membrane end up. The skin was sutured to the skin margin of the sinus with two silk sutures. The tube was removed on the eighth day; apparently the graft was

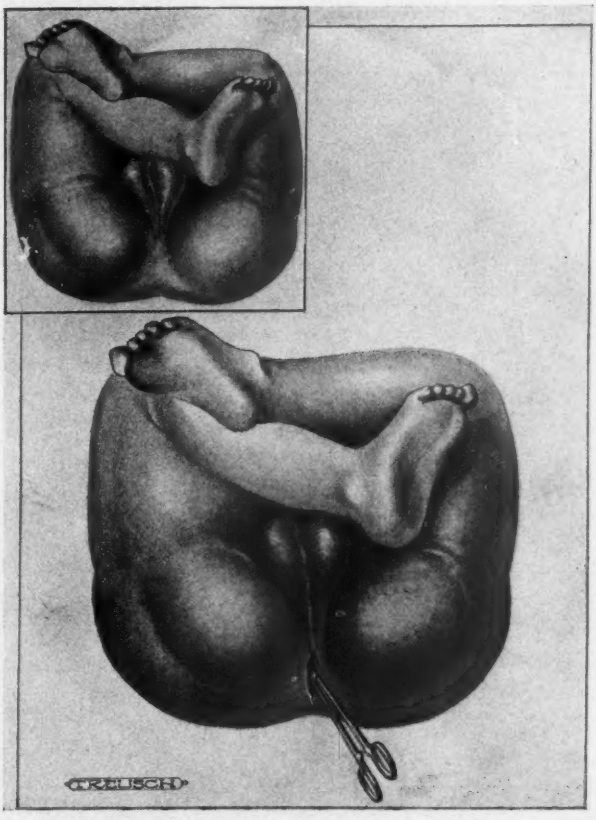

Fig. 1. Imperforate anus, showing incision and blunt dissection with sharp-pointed artery forceps.

successful as the greater portion of the sinus was lined with epithelium. A small rubber catheter well lubricated with vaseline was passed daily for several days. The patient was kept in the hospital under observation three more weeks and dismissed as cured April 28.

The parents were instructed to pass the lubricated catheter at intervals.

The parents were ignorant tenant farmers. Apparently they knew nothing about the care of children. The baby was readmitted in July, 1934, at the age of 3½ months in a critical condition from acute enterocolitis. He died a few hours later. Permission for necropsy could not be secured.

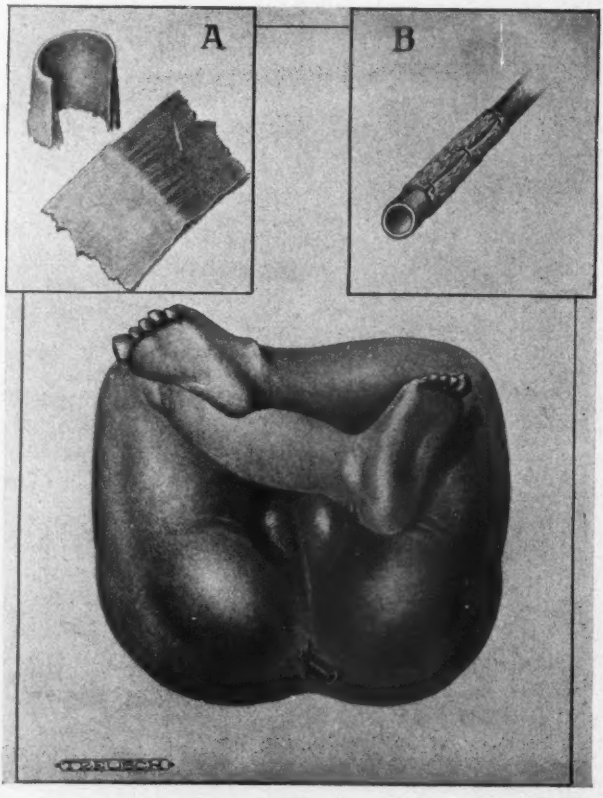

Fig. 2. Graft around tube sutured into granulating tract. (A) Prepuce incised and the skin and mucous surfaces separated. (B) Prepuce sutured around tube raw surface out, before inserting into tract.

Since the primary operation had apparently been successful, it was hoped that this patient would live to have a plastic operation later to give him muscular control of his rectum.

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With this issue THE SOUTHERN SURGEON enters its seventh year. That almost makes it of age as medical journals go. Though the SURGEON has not yet accomplished all the ends for which it was designed, it is still growing both in volume and in circulation, and it is still in the black, so its Editors face the future with assurance.

The most encouraging thing about the last year is the general geographic distribution of the papers. Alabama led with six; Kentucky, Louisiana and Tennessee tied for second place with five each; Virginia, North Carolina and South Carolina contributed four apiece. Georgia, the natal state of this journal, could only tie Florida in the fourth rank. Mississippi brings up the tail end of the list of States in the Congress with two. Pennsylvania, Texas, Minnesota, New York, Maryland, Ohio, Illinois and Kansas have kept the journal from appearing provincial.

The SURGEON is proud that in the spring of 1937 it published a contribution by Dr. Charles Gordon Heyd, President of the American Medical Association, and later in the year one by the newly inducted President, Dr. J. H. J. Upham. A former President, Dr. Haggard, has also published a scholarly and practical paper in these pages. The President-elect, Dr. Irvin Abell, has secured for us valuable papers from his recent students.

The SURGEON is also proud that in 1937 it published twenty-three papers that had not been read before the Assembly of The Southeastern Surgical Congress. Some of these were maiden efforts, many were by younger surgeons, but all were good. The Editors hope that, in addition to the drawer full of such papers now on hand, they will be swamped by contributions from the up and coming young men of the South during 1938.

BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

THE COLLAPSE THERAPY OF PULMONARY TUBERCULOSIS. By JOHN ALEXANDER, B. S., M. A., M. D., F. A. C. S., Professor of Surgery, University of Michigan, Surgeon-in-Charge, Division of Thoracic Surgery, Department of Surgery, University of Michigan Hospital. With Contributions by MAX PINNER, M. D., F. A. C. P., Herman M. Biggs Memorial Hospital, Ithaca, New York, etc.; by JOHN BLAIR BARNWELL, B. A., M. D., Associate Professor of Internal Medicine, University of Michigan, etc.; by KIRBY SMITH HOWLETT, JR., M. S., M. D., Resident Laurel Heights State Tuberculosis Sanatorium, Shelton, Conn. 705 pages, with 367 figures and 16 tables. Price, $15. Springfield and Baltimore: Charles C Thomas, Publisher, 1937.

This well planned and painstakingly executed book opens with a statistical presentation of the value of collapse therapy over unaided sanatorium treatment. Anyone interested in the treatment of pulmonary tuberculosis will be impressed by the outstanding advantage of a well chosen collapse therapy regime and should be stimulated to learn more of this treatment which offers a patient with pulmonary tuberculosis his greatest chance of being "cured." The book is based upon experience with collapse therapy in approximately 1800 cases, a study of some 1700 articles and books, and observations in other leading thoracic surgery clinics.

An historical review of the evolution of surgical therapy of pulmonary tuberculosis from the time of Hippocrates is given in Chapter II. However, the greatest advances have been made in the last decade. Since Dr. Alexander's first book, "The Surgery of Pulmonary Tuberculosis," was published twelve years ago, most of the operations have been radically revised, some new ones introduced, and the number of patients with bilateral active tuberculosis, of extensively destructive unilateral lesions treated surgically has been greatly increased.

This book has been written for internist and surgeon. Both should appreciate the physiologic principles and pathology of pulmonary collapse therapy presented in the chapters by Dr. Pinner. A clear conception of these chapters will make a more intelligent understanding of the rest of the book possible.

In Chapter V, the basis for the choice of operation is given and the ten operative procedures to be detailed later are briefly discussed. These in the order of their presentation are: phrenic nerve paralysis, scaleniectomy, pneumothorax, intrapleural pneumonolysis, oleothorax, multiple intercostal nerve paralysis, extrapleural pneumonolysis, supraperiosteal pneumonolysis, thoracoplasty, and cavity drainage. These operations are used singly and in various combinations. The suggested collapse therapy for 84 types of pulmonary and pleural lesions is given in the diagrams (representing roentgenograms) and legends of Figures 31 to 114 inclusive. Chapter VI presents a consideration of bilateral collapse therapy.

The following chapters deal with the various operations. Much attention is given to the proper selection of patients for these several operations, as well as to operative technic and preoperative and postoperative management. Detailed information is also given regarding indications, contraindications, the anatomy involved, instruments used, operative accidents and postoperative complica-

tions. The results of each operation alone or in combination with other procedures obtained by the author and by other thoracic surgeons are presented statistically. The results for each operation are followed by a section of conclusions which emphasizes the important points of its chapter.

The vivid description of operative accidents and postoperative complications should lend weight to the author's warning that "less than two years of intensive training is insufficient to prepare a surgeon to practice thoracic surgery with confidence, and insufficient to equip him to serve as a competent consultant."

The numerous details and statistics throughout the book make it slow reading, but these very features add greatly to its value as a reference book which should be available to every doctor practicing collapse therapy. If a considerable number of our doctors will carefully read this book, the treatment of pulmonary tuberculosis in the south will surely be improved.

A. PARK MCGINTY, M. D.

SURGICAL PATHOLOGY OF THE DISEASES OF THE NECK. By ARTHUR E. HERTZLER, M. D., Surgeon to the Agnes Hertzler Memorial Hospital, Halstead, Kansas; Professor of Surgery, University of Kansas. 237 pages, with 206 illustrations. Price, $5. Philadelphia, Montreal and London: J. B. Lippincott Company, 1937.

A year ago THE SOUTHERN SURGEON had the honor of publishing Dr. Hertzler's paper, "Tumors of the Neck." His new book is essentially an elaboration of that paper, with many new photographs of patients, as well as many gross and microscopic photographs of tissue.

His thesis is that Hodgkin's disease is still essentially a surgical condition. Since the roentgenologist has not been able to increase the life expectancy of a patient with this disease over that offered by a careful surgeon, and since there is always the possibility of a mistake in diagnosis, he urges that the surgeon perform a clean dissection and then submit the patient for x-ray therapy.

His good old American common sense, well salted with his old American humor, makes the book good reading. These very factors may make some highbrow pathologists look askance at the monograph, but the man who is actually doing surgery should welcome it and profit greatly by it.

DISEASES OF THE HEART. By SIR THOMAS LEWIS, C. B. E., F. R. S., M. D., D. Sc., LL. D., F. R. C. P., Physician in Charge of Department of Clinical Research, University College Hospital, London; Honorary Consulting Physician to the Ministry of Pensions; Consulting Physician, City of London Hospital; Fellow of University College, London. Second edition. 297 pages, with 45 illustrations. Price, $3.50. New York: The Macmillan Company, 1937.

The first edition of Lewis's book was acclaimed as a masterpiece of literature, a text that sketched vividly the clinical pictures of heart disease. It was permeated with his skill in applying to bedside medicine knowledge secured from extensive research with instruments of precision. It was also illumined with brilliant prognostic dicta. The book however was intensely individualistic, as he not only admitted but proclaimed. It is not surprising therefore that three years later he has not found many pages in need of alteration.

Lewis is much more rabid in his condemnation of the use of tobacco by cardiac patients than most modern writers. He also refuses to accept some of the principles of digitalis therapy announced by Withering in 1785 although these principles have in recent years been strongly supported by many investigators, particularly in America.

NEUROLOGY. By ROY R. GRINKER, M. D., Chairman, The Department of Neuropsychiatry of the Michael Reese Hospital, Chicago; Formerly Associate Professor of Neurology and Psychiatry, The University of Chicago. Second edition. 999 pages, with 406 illustrations. Price, $8.50. Springfield and Baltimore: Charles C Thomas, Publisher, 1937.

Many textbooks of neurology have proved heavy, cumbersome and confused. The author of such a book, it has always seemed to the reviewer, either was not able himself to think clearly or he was not willing to take that trouble. Therefore to take up a book on neurology that is written with the freshness and enthusiasm of a sophomore, but the authority and precision of a scholar, is a real pleasure.

Dr. Grinker states that errors and omissions in the first edition have been corrected and that he has attempted to integrate in the text the advances in the various fields of fundamental and clinical neurology. He has produced a book that is remarkable in its completeness.

Now that the large clinics find that some 10 per cent of their operations are required by neurologic conditions, it behooves every surgeon to take such conditions into consideration in every case.

Mr. Thomas, as usual, has made a splendid job of his part of the book.

THE BUSINESS SIDE OF MEDICAL PRACTICE. By THEODORE WIPRUD, Executive Secretary of The Medical Society of Milwaukee County; Lecturer in Medical Economics at the Marquette University School of Medicine. 177 pages with 21 illustrations. Price, $2.50. Philadelphia and London: W. B. Saunders Company, 1937.

The young physician just starting out on his own should find this book invaluable. Many men already well established should find good points in it with reference to the management of their offices, and the book may be particularly recommended to their secretaries.

Chapters on the preparation of medical papers and on their presentation are wholly admirable. Their careful study, especially their emphasis on brevity, by all contemplating such activities would improve medical literature, and add vastly to the enjoyment of many medical meetings.

THE TECHNIC OF LOCAL ANESTHESIA. By ARTHUR E. HERTZLER, A. M., M. D., Ph. D., Professor of Surgery in the University of Kansas, Kansas City, Kansas. Sixth edition. Price, $5. 284 pages. St. Louis: C. V. Mosby Company, 1937.

Dr. Hertzler presents here the fifth revision of his admirable little text on local anesthesia. It tells all that it is necessary to know about the small number of good local anesthetics and it also discusses the combination of local and general. Dr. Irene A. Koenecke contributes a special chapter on spinal anesthesia. In keeping with the general consensus of today, this chapter does not take up very much space.

Dr. Hertzler's own favorite use of local anesthesia is by the infiltration method. This method is certainly the simplest and, by and large, the most satisfactory and therefore one that is best suited to the needs of the largest number of general surgeons.

MATERIA MEDICA, PHARMACOLOGY, AND THERAPEUTICS AND PRESCRIPTION WRITING. By WALTER ARTHUR BASTEDO, Ph. M., M. D., Sc. D., F. A. C. P., Consulting Physician, St. Luke's Hospital, New York, St. Vincent's Hospital, Staten Island, and the Staten Island Hospital; President, United States Pharmacopoeial Convention 1930-1940; Member Revision Committee U. S. Pharmacopoeia, etc. Fourth edition, reset. 778 pages, with 81 illustrations. Price, $6.50. Philadelphia and London: W. B. Saunders Company, 1937.

Too many of us rely upon the detail men to supply us with our graduate education in materia medica and pharmacology. This reviewer would be the last man in the world to decry the efforts of those men who represent the top-flight houses (the pharmaceutical firms to whom the advertising pages of THE SOUTHERN SURGEON are open), for he owes them much. On the other hand, one should bear in mind that such representatives are not altogether disinterested. It is therefore well for the practicing physician to cast an anchor to windward and restrain his therapeutic enthusiasm with a solid, scientific, up-to-date work like the new edition of Bastedo. This work includes the best description of glandular therapy that has come to the reviewer's attention.

APPENDICITIS: A CLINICAL STUDY. By W. H. BOWEN, Hon. M. A. (Camb.), M. S. (Lond.), F. R. C. S., Hon. Surgeon to Addenbrooke's Hospital, Cambridge; Hon. Consulting Surgeon to Royston County Hospital; Examiner in Surgery, University of Cambridge; Formerly Hon. Surgeon to the East London Hospital for Children; formerly Hon. Surgeon to the East London Hospital, etc. 202 pages. Price, $2.50. Cambridge: at The University Press. New York: The Macmillan Company, 1937.

Fearing that it was "just another book," the reviewer picked up this little volume totally without enthusiasm. The introduction, however, intrigued his interest and he wound up by reading every word of the book. He advises the surgeon, "Go thou and do likewise;" it should lower his mortality in the treatment of this disease.

Mr. Bowen writes well and, in particular, his chapter on chronic appendicitis is superb.

EXTERNAL DISEASES OF THE EYE. By DONALD T. ATKINSON, M. D., F. A. C. S., Consulting Ophthalmologist to the Santa Rose Infirmary and the Nix Hospital, San Antonio, Texas; Fellow of the American Academy of Ophthalmology and Oto-Laryngology, etc. Second edition, revised and enlarged. 718 pages, with 494 engravings. Price, $8. Philadelphia: Lea & Febiger, 1937.

Dr. Atkinson includes in "External Diseases of the Eye" almost every condition of the eye in front of the retina, including ocular manifestations of allergy and other general conditions. These conditions obviously include the large majority of affections of and around the eye. It is surprising to see how many they are. He emphasizes the close relationship of the paranasal sinuses to diseases of the eye. He has taken the trouble to write concisely and clearly.

In addition to a large number of photographs gathered from different parts of the United States and Mexico, as well as from his own practice, he has been fortunate in being able to illustrate his book with drawings and photographs of wax models made by himself.

The chapter on "Hygiene of the Eyes" should prove valuable to every doctor in the care of his own eyes, and perhaps even more so in the protection of his children's eyes. The value of the book is further enhanced by a formulary to enable the general practitioner to prescribe intelligently for some of the simpler conditions.

Students and indeed every physician who is not closely allied with an experienced ophthalmologist should do well to study this book and to keep it at hand for ready reference.

TEXTBOOK OF SURGICAL NURSING. By HENRY S. BROOKES, JR., M. D., Instructor in Clinical Surgery, Washington University School of Medicine; Surgeon to the Out-Patients, Washington University Dispensary; Assistant Surgeon to Barnes Hospital, St. Louis. 636 pages, with 233 illustrations. Price, $3.50. St. Louis: The C. V. Mosby Company, 1937.

The author of this well illustrated text has succeeded in putting in very short space just about everything a nurse should know about surgical technic. Not only is it packed with sound teaching but it is also written attractively. Indeed medical students might well spend a few hours with it to get a bird's eye view of surgery before going into the details in their regular course. The reviewer's only objection is to the advocacy of the soapsuds enema which he thought had been practically abandoned.

PRACTICAL TALKS ON KIDNEY DISEASE. By EDWARD WEISS, M. D., Professor of Clinical Medicine, Temple University School of Medicine, Philadelphia. 176 pages. Price, $3. Springfield and Baltimore: Charles C Thomas, Publisher, 1937.

A century after Richard Bright undertook his incomparable study of medical conditions of the kidney, Dr. Weiss presents this superb little book which summarizes today's knowledge of the subject.

SYNOPSIS OF GYNECOLOGY. Based on the Textbook DISEASES OF WOMEN. By HARRY STURGEON CROSSEN, M. D., F. A. C. S., Professor Emeritus of Clinical Gynecology, Washington University School of Medicine; Gynecologist to the Barnes Hospital; Fellow of the American Gynecological Society, etc., and ROBERT JAMES CROSSEN, M. D., Assistant Professor of Clinical Gynecology and Obstetrics, Washington University School of Medicine; Assistant Gynecologist and Obstetrician to the Barnes Hospital, etc. Second edition. 247 pages, with 106 illustrations. Price, $3. St. Louis: The C. V. Mosby Company, 1937.

Of course anyone actually engaged in the practice of gynecology must have at least one book that deals with the subject exhaustively and is abundantly illustrated. It may be that the impecunious undergraduate who has access to the larger books and who has also the guidance of experienced men can make out by purchasing only this outline: its substance he can master.

CRIPPLED CHILDREN: THEIR TREATMENT AND ORTHOPEDIC NURSING. By EARL D. MCBRIDE, B. S., M. D., F. A. C. S., Assistant Professor in Orthopedic Surgery, University of Oklahoma, School of Medicine; Chief of Staff to Reconstruction Hospital, Oklahoma City, Okla., and WINIFRED R. SINK, A. B., R. N., Educational Director, Grace Hospital School of Nursing, Detroit, Mich.; Formerly Head Nurse of James Whitcomb Riley Hospital of the Indiana University Group. Second edition. 379 pages, with 195 illustrations. Price, $3.50. St. Louis: The C. V. Mosby Company, 1937.

Crippled children, like the poor, we have had always with us, and yet today they seem to be more on our consciousness than ever before. Surely there is no more worth while undertaking for a surgeon than to restore one of these little ones to a life of self-respect and economic independence. And yet in no type of work is good nursing more important.

The orthopedist should welcome this book as it will be of the greatest help to him in instructing his nurses in what is expected of them.

HEALTH EDUCATION AND THE PUBLIC. *A Practical Manual of Technic.* By W. W. BAUER, B. S., M. D., Director, Bureau of Health and Public Instruction, American Medical Association; Associate Editor of Hygeia, The Health Magazine, and THOMAS G. HULL, Ph. D., Director, Scientific Exhibit, American Medical Association; Associate Professor of Bacteriology, University of Illinois, College of Medicine. 227 pages with 39 illustrations. Price, $2.50. Philadelphia and London: W. B. Saunders Company, 1937.

Whether we like it or not the medical profession must have a better press. We must have better support from the public in order to secure legislation for the protection of the public and we must forestall legislation to regiment us.

Those physicians who are charged by their brother doctors with the responsibility of educating the public should secure for their guidance a copy of this book.

THE POSTMORTEM EXAMINATION. By SIDNEY FARBER, M. D., Associate in Pathology, Harvard Medical School; Pathologist to The Infants' Hospital and The Children's Hospital, Boston. 201 pages, with 32 illustrations. Price, $3.50. Springfield and Baltimore: Charles C Thomas, Publisher, 1937.

It is of course today impossible to exaggerate the importance of physiologic chemistry, physiology and pathologic physiology. Nor should one depreciate endocrinology or psychiatry. But there has been a tendency among some of the younger brethren who pride themselves on being scientific and progressive to boost these subjects at the expense of an older subject and to turn up their noses at pathology. While one must admit he never heard of a pathologist growing rich in the practice of his profession—and according to the standards of some Americans this in itself would damn the science—this reviewer still believes that morbid anatomy is the cornerstone of clinical medicine. He does not believe that a doctor can be really scientific without understanding pathology, really good without a high percentage of autopsies on patients who die under his care. He therefore is delighted to acclaim this excellent manual of postmortem technic.

DISEASES OF THE NERVOUS SYSTEM IN INFANCY, CHILDHOOD AND ADOLESCENCE. By FRANK R. FORD, M. D., Associate Professor of Neurology, The Johns Hopkins University. 952 pages with 107 illustrations. Price, $8.50. Springfield and Baltimore: Charles C Thomas, Publisher, 1937.

There has been a definite need for a thorough presentation of the diseases of the nervous system in infancy and childhood, which is adequately fulfilled in this book. The first two chapters deal with the examination of the nervous system in children and clinical aspects of the anatomy and physiology of the nervous system. This is followed by a discussion of prenatal diseases, hereditary and familial diseases, infections and parasitic invasions, toxic and metabolic disorders, vascular and circulatory disorders, neoplasms, injuries, the epilepsies and paroxysmal disorders, diseases of the autonomic system and diseases of the muscles. There are 133 case reports illustrating various conditions, which help much to make the subject clear and add to the value of the book. The final chapter deals with syndromes and symptom groups, and this should be of much help for quick reference. This chapter deals with differential diagnosis of such conditions as spastic paralysis, muscular atrophies, transient palsies, ataxias, involuntary movements, pain and sensory disorders, coma and delirium, fits and disturbed speech. The book should be in the hands of all pediatricians and may be highly recommended to all who deal with diseases of children.

WILLIAM A. SMITH, M. D.

THE ROENTGENOLOGIST IN COURT. By SAMUEL WRIGHT DONALDSON, A. B., M. D., F. A. C. R., St. Joseph's Mercy Hospital, Ann Arbor. 230 pages. Price, $4. Springfield and Baltimore: Charles C Thomas, Publisher, 1937.

One of the most annoying things about the practice of medicine today is the readiness of patients to sue their doctor. One is indeed often led to secure unnecessary expensive examinations the patient can ill afford lest he sue for not having had them. We have of course long since learned for our own self-preservation to secure a number of x-rays of even the simplest fractures both before and after reduction.

This book is recommended to all physicians. Even though its guidance should not be needed, it will afford a few hours of interest.

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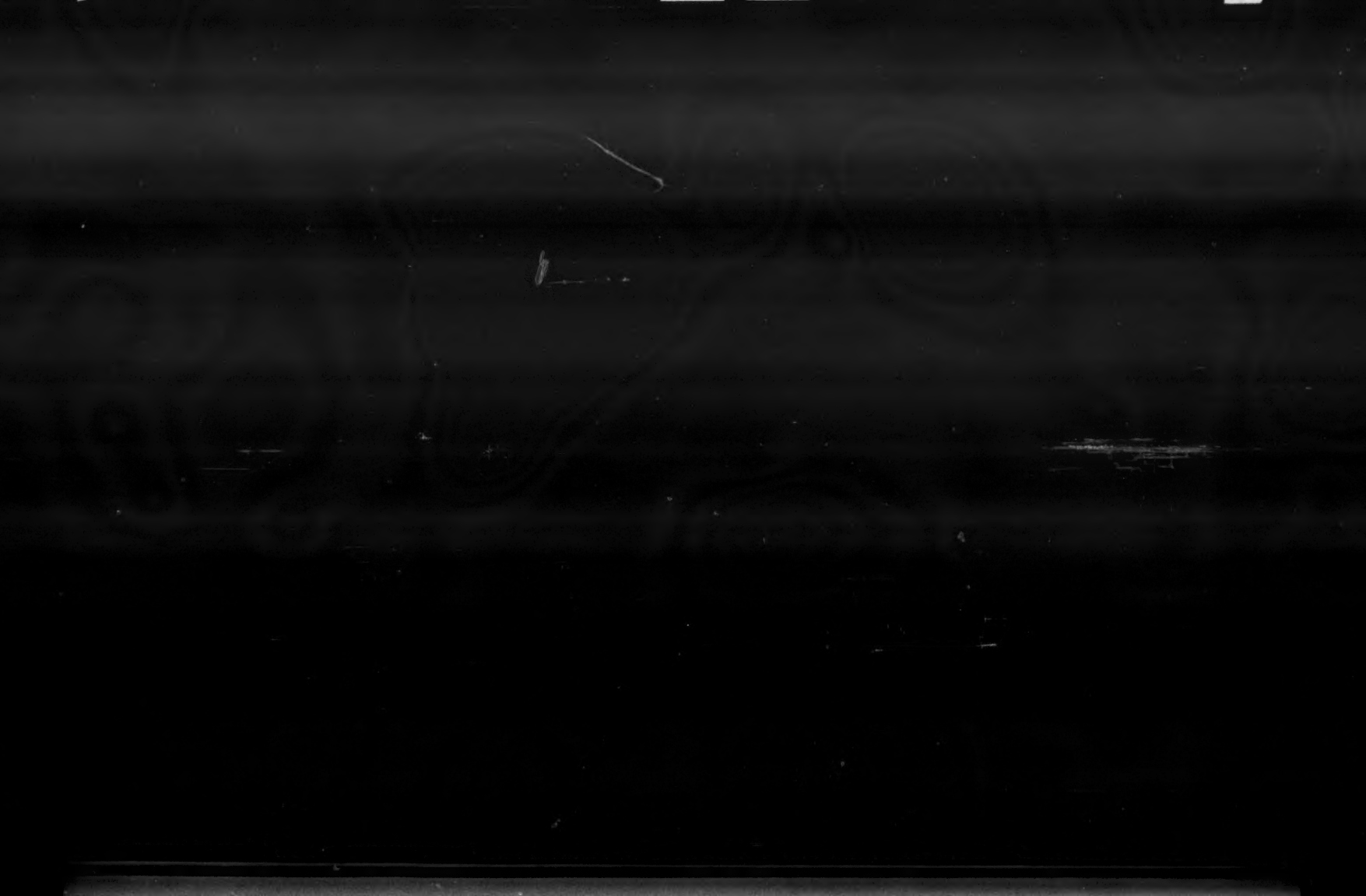
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